The Dissertation Committee for Lisa Kleinman Certifies that this is the approved version of the following dissertation:

Physically Present, Mentally Absent? Technology Multitasking in Organizational Meetings

Committee:

Andrew P. Dillon, Supervisor

Randolph G. Bias

Gary K. Geisler

William E. Hefley

Sirkka L. Jarvenpaa

Physically Present, Mentally Absent?
Technology Multitasking in Organizational Meetings

by

Lisa Kleinman, B.S., M.B.A.

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Dedication

To my parents:

Theodore & Han Pun Kleinman

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Physically Present, Mentally Absent?
Technology Multitasking in Organizational Meetings

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Supervisor: Andrew Dillon

This research examines mixed reality meetings, a context where individuals attend to both face-to-face group members while multitasking with technology. In these meetings, members engage simultaneously with those physically present and those outside of the meeting (virtual communication partners). Technology multitasking in meetings has a dual effect: it not only impacts the individual user, it has the potential to transform how collocated groups communicate and work together since attention becomes fragmented across multiple competing tasks.

Qualitative and quantitative methods were used to investigate mixed reality meetings across four themes: (1) the factors contributing to the likelihood to multitask based on *meeting type, polychronicity* (one's preference for multitasking), and *cohesion beliefs*, (2) behavior during mixed reality assessed by *copresence management*, (3) attitudes toward *technology multitasking*, and (4) subjective outcomes measured by *perceived productivity* and *meeting satisfaction.* The qualitative data set consists of fieldwork from a global software company and interviews with 8 information workers.

The quantitative data are comprised of survey results from the fieldwork site (n=156) and an online panel of information workers (n=110).

Results indicate that information workers perceive distinct meeting types that are associated with implicit norms for appropriate technology multitasking. These norms varied based on the relevance of a meeting segment and if a power figure was present. A higher preference score for multitasking (high polychronicity) was significantly correlated with increased technology multitasking and perceived productivity. Members of cohesive teams exhibited the most technology multitasking and perceived their teammates multitasking as appropriate. However, outsiders who exhibited the same behaviors were viewed as rude and distracting. Overall, information workers who multitasked during meetings did so with electronic communication tasks (e-mail and instant messaging) as opposed to other computing tasks (e.g. writing documents, researching information).

These findings are discussed in relation to psychological studies on multitasking, computer-supported cooperative work, and social constructionist views of technology use. This dissertation is a contribution to the assessment of technology use in social settings, particularly in organizations where tasks are often interrupted and a reliance on electronic communication tools impacts how people manage and accomplish work.

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CHAPTER 1: *INTRODUCTION*

INFORMATION WORK & MIXED REALITY

In the typical work day, information workers manage multiple activities at the same time; they answer telephone calls, glance at e-mail, click to another program to browse the web, and perhaps look around to notice who else is nearby. Information workers are people whose daily work activities rely on the use of computing technologies to manage and produce knowledge. One of the salient characteristics of information work is that it often involves layering multiple activities or tasks. The act of switching between tasks while concurrently working on them is called multitasking (Czerwinski, Horvitz, & Wilhite, 2004; Wasson, 2004) and for simple activities people multitask without much effort. It is rare for workers not to be multitasking, in fact, it is expected in most organizations that people will manage their usage of time to handle different work activities simultaneously (Kaufman-Scarborough & Lindquist, 1999).

Information work has become increasingly prevalent as a field of work due in part to increased use of electronic communication (e.g. e-mail and instant messaging) and the pervasiveness of portable technologies such as laptops and mobile phones. Electronic mail is the primary online activity on the Internet (Pew Internet Research, 2003) and instant messaging, which was originally perceived as a communication tool for casual socializing, has now become an essential business tool (Forrester Research, 2007). This increased reliance on technology for work tasks has changed the nature of multitasking in the workplace. Previously, people were limited to working from their desks where computers and phones were accessible. Today, technologies are no longer tethered to one location and this leads workers to multitask in work contexts previously not possible. The increased use and reliance on technology for work tasks in combination with access to portable technologies leads some workers to habitually multitask throughout the day.

Definition of Technology Multitasking and Mixed Reality

One area of the work day that has been impacted by this continuous multitasking is group meetings. Some workers use laptops or other portable devices like smartphones (a mobile phone with additional features such as e-mail, access to web sites, and text messaging) during meetings while simultaneously participating in the meeting. Sometimes the technology is assisting the worker with the group meeting, and at other times the technology is used to complete tasks unrelated to the group. This multitasking has consequences both intended and unanticipated by the technology user. Rennecker & Godwin (2005) describe these dual technological impacts as first- and second-order effects, where the first-order effect is technology helps organize and improve workplace communication, and the second-order effect is an increase in interruptions (and therefore disorganization) to the workplace. When *multitasking* is used as a term in this dissertation, it refers to these layered and interleaved work activities. If this multitasking involves a portable technology, then it is identified as *technology multitasking* in this research.

The fact that individuals multitask with technology in meetings is a complex issue because the impacts are both beneficial and potentially distracting to group work. In this dissertation, *mixed reality* is the term used to describe this context where group members attenuate between both the physically present group and the use of technology. The term, mixed reality, is borrowed from virtual reality researchers who use it to describe environments where physical and digital objects exist together (Costanza, Kunz, & Fjeld, 2009). In this research, the term is applied to organizational groups where members may be communicating with others both physically present and absent (electronic communication partners). Individuals in this mixed reality environment work on a mixture of tasks, some related to the group and others not. In mixed reality settings, workers are faced with decisions on how to attend between information to be learned or shared from face-to-face communication and information to be conveyed or processed using technology. This research investigates how individual and group factors contribute to creating mixed reality and the impact this new context has on the social processes and behaviors of group members.

MOTIVATION & SIGNIFICANCE OF THE RESEARCH

The nature of technology use in group meetings has changed over the last ten years. Through the mid-1990s most computing was confined to a user's physical desk space because technologies like the desktop computer are not easily portable. When technology was being used in group settings, it was generally mandated as part of the meeting. For example, a group leader would hold a meeting with a computer terminal available for each team member to use for a pre-designated purpose (such as casting an electronic vote). Another example of technology use in groups was a shared electronic workspace that was controlled by a designated scribe; team members would contribute an idea and the scribe would update the electronic workspace to reflect team inputs. In these traditional uses of computing in groups, everyone in the meeting was using the same technology in similar ways.

Prior Research on Technology Use in Group Settings

Electronic Meeting Support (EMS) and Group Support Systems (GSS) were the two main research streams for investigating technology and group work in the late 1980s through the mid-90s (e.g. Baecker, 1995 and Scott, 1999). Both EMS and GSS were specific hardware and software systems that were developed to enhance face-to-face meetings, but they differ in the type of group processes they intended to support. EMS consisted of meeting rooms where each member was given a personal computer terminal which was networked to a shared group computer and/or a large shared display. EMS was developed to support collaborative work such as creating a group presentation or any other tasks where multiple members needed to see and share information amongst each other. Group Support Systems were developed to enhance group tasks such as decision making, voting, and brainstorming. The typical GSS setup consisted of networked computers in which members submitted their vote or idea which was then broadcast anonymously on a large shared display using a software program designed for the task.

GSS studies differ from EMS research by enhancing a specific group task (e.g. decision making) by modifying how group members contribute ideas, whereas Electronic Meeting Support seek to augment the entire communication and collaboration processes of the group. Another key difference between EMS and GSS is that EMS studies tended to be exploratory and not experimental. The focus of most EMS studies was on the development of networked technology-enhanced rooms; the study results were reported as a description of events as people worked in these new settings (e.g. Halonen, Horton, Kass, & Scott, 1990; Stefik et al., 1988). GSS studies, on the other hand, were typically experiments in which specific aspects of group decision making were tested with the purpose of improving teamwork using quantitative validity (see Scott, 1999 for a review of GSS research). The relevance of these GSS and EMS research streams are further discussed in the literature review (Chapter 2).

Since that time, the development of multiple types of portable technologies has changed where computing takes place in the office and this has impacted organizational meetings. Workers are now easily able to carry laptops, mobile phones, personal digital assistants and other forms of technology into meetings where the use of technology is no longer mandated or controlled by the meeting leader. And, the proliferation of wireless networking and associated software applications now means that these technologies can support more communication and information tasks than previously possible. Lyytinen & Yoo (2002) describe cellular and wireless networks as nomadic information environments since it allows people to connect to multiple sources of information regardless of physical location both inexpensively and quickly.

Relevance of Collocated Group Work

With this increased access to information, the attention of group members may begin to compete between the meeting at hand and the technology. When we communicate face-to-face, individuals use non-verbal cues such as facial expressions and posture, and verbal cues like tone of voice and cadence to convey information (Schober & Brennan, 2003). There is also a feedback process between speakers and listeners with structured patterns for how dialogue is acknowledged and proceeds. The presence of portable technologies allows users to break from these traditional conversational cues, creating new challenges for understanding group work. For example, technology users may miss nonverbal cues such as a nodding of head when their attention is focused on the technology.

While the use of technology in teams, particularly for distributed/virtual groups, has become common with videoconferencing and online chatting, the need for collocated team meetings persists. When group members are proximate to each other, they are able to communicate more efficiently and with greater richness compared to distributed teams (Kiesler & Cummings, 2002). Teams that are collocated have more continuous communication which makes coordination and learning easier (Olson, Teasley, Covi, & Olson, 2002). Field research by Olson et al. found that radically collocated teams (team members who all work in a shared project room) are twice as productive as teams that are "merely nearby." However, when workers multitask with technology the concept of collocation becomes fragmented as team members are no longer fully present as they attend to both group members and technology. This change in team meetings to a mixed reality environment elicits many questions for how group work is changed.

The issue of how people multitask in groups is significant to study because there are currently few studies that explore the implications it has on individuals and group processes. This research can help inform the design of technologies to support the way people multitask across varying contexts. Previously, research on group work did not need to consider the impact of technology multitasking as either an enhancement or disruption to team meetings because it was presumed that everyone was working in similar ways. As technologies began to enter group settings, the research that examined group processes assumed that each group member worked simultaneously and in similar ways with the technology. In mixed reality, there is no preordained manner in which technology is used, and its use is not constant or necessarily predictable across group members. This research will extend and contribute to our theoretical understanding of group work by examining how technology multitasking occurs and how the social processes and behaviors of individuals are impacted in group settings.

RESEARCH OVERVIEW & QUESTIONS

This research takes a broad approach to mixed reality by focusing on four main areas of the phenomenon: 1) the individual and group factors that lead to technology multitasking in meetings, 2) the behaviors of people during mixed reality meetings, 3) the attitudes of group members in mixed reality, and 4) the productivity and satisfaction outcomes of these meetings. These four areas are first united into a conceptual model that is developed from the literature review and pilot study.

Then, there are two phases of research which aim to validate the conceptual model: a qualitative phase consisting of fieldwork and interviews with real world information workers, and a quantitative phase using survey data collected from information workers from across the United States. The survey employs hypothesis testing with questions developed from the conceptual model and qualitative results (see Table 1 below). The first row in the table, Proposition 1 (P1), is defined as a proposition and not a hypothesis because no specific prediction is made in advance about which types of meetings contribute to technology multitasking.

Research Hypotheses
P1: The context of the meeting (the meeting type) will influence the decision to multitask with technology.
H1: Individuals high in polychronicity will multitask with technology more than those low in polychronicity.
H2: Individuals who are highly cohesive with their teams will multitask less.
H3: Managers will multitask with technology more than non-managers.
H4a: Individuals high in polychronicity will manifest greater electronic copresence.
H4b: Individuals low in polychronicity will manifest greater in-room copresence.
H5: Individuals who feel cohesive with their immediate team will have greater in-room copresence.
H6: Individuals who feel cohesive with their team will believe that others on their team multitask appropriately.

H7: Individuals high in polychronicity will have higher self-efficacy with technology multitasking.
H8: Individuals high in polychronicity will perceive meetings as more productive when technology multitasking occurs.
H9: Individuals who feel cohesive with their immediate team will perceive less productivity with technology multitasking.

Table 1: Summary of Research Hypotheses.

STRUCTURE OF DISSERTATION

This dissertation is organized into six chapters followed by the appendices containing the interview protocol, survey questionnaires and supplementary data. A brief overview of each chapter is presented here:

Chapter 1: Introduction. The phenomenon of mixed reality is defined and the scope of the research is presented in brief and the research questions are introduced.

Chapter 2: Literature Review. A detailed review of existing work that pertains to the research questions is examined. The relationship of this prior work is discussed as it relates to mixed reality.

Chapter 3: Methodology. A description of the qualitative and quantitative methodology used to investigate the topic. Chapter 3 includes the results from a pilot study (15 interviews) as it relates to methodological implications and a presentation of the conceptual model that is derived from the literature review and pilot work.

Chapter 4: Qualitative Results (Phase 1). The results from fieldwork at a software corporation are presented and the data from 8 focused interviews with information workers.

Chapter 5: Quantitative Results (Phase 2). The results from two survey waves are discussed. The first survey wave (n=156) consists of data collected from the software corporation used in Chapter 4, and the second survey wave (n=110) is obtained from an online panel of information workers.

Chapter 6: Discussion & Conclusion. The results from both the qualitative and quantitative phases are discussed and a case is built for the implications of this data. Applications for this research are presented as it relates to theory and management, and the limitations of this work are addressed.

Appendices. All research instruments are presented in the appendices including interview protocols and survey questionnaires.

CHAPTER 2: *LITERATURE REVIEW*

In Chapter 2 the conceptual model used to address the research themes is presented. The model uses an input-process-output framework that links the individual and group factors contributing to mixed reality (inputs) to the behaviors and attitudes of team members in these meetings (processes). These processes are then related to meeting outcomes of productivity and satisfaction (outputs). This model is developed from the literature review which analyzes the major theoretical constructs about individual behaviors in groups as it relates to technology multitasking.

INPUT-PROCESS-OUTPUT FRAMEWORK

Relationship of Mixed Reality to Prior Research

In its most basic abstraction, mixed reality is a context where some people use technology in group meetings. The study of technology use in group meetings is not a new research area—it has been a well-established area of study since the feasibility of using technology for group work has been possible. However, most of the prior research on this topic has focused on how a specific technology given to all members improved group work, such as studies on electronic voting systems (e.g. Baecker, 1995; Scott, 1999), groupware for editing documents collectively (e.g. Stefik et al., 1988) and electronic meeting rooms (e.g. Halonen et al., 1990). In these previous studies of technology use in meetings, every group member had access to the same technology and generally worked collectively with the technology, which was viewed as an embellishment to the group meeting. In mixed reality, the type of technologies used and the tasks accomplished are not the same across group members. Furthermore, this research does not assume that technology is an enhancement to the group since its use also has the potential to detract from the group.

Another fundamental viewpoint difference between this research and many previous studies about technology use in groups is that the focus is not on trying to understand if technology use gives rise to an immediate performance outcome. In this research, group performance is viewed from a social perspective meaning that technology use is studied as it impacts member's behaviors and interpersonal relationships in the team dynamic. Successful group performance in this social perspective is a byproduct of a team that works well together. Essentially, groups that work well are deemed to be cohesive (for a review of social cohesion see Friedkin, 2004), which is defined here as the combination of individual task commitment along with positive interpersonal interactions between members which form a sense of bonding and unity across a team.

Input-Process-Output Constructs

To explain this diversity in how mixed reality meetings occur, seven constructs will be used in this literature review to inform the conceptual model. In this review, these constructs serve as guiding points to relate different theoretical perspectives in explaining mixed reality. The purpose of the model is to:

- explain how mixed reality occurs through a combination of individual factors and group norms,
- link these individual factors and group norms to the different ways technology multitasking occurs in meetings, and to the different attitudes and behaviors of group members, and

- demonstrate how mixed reality can be assessed as it impacts the social outcomes of individual team members through perceived productivity and meeting satisfaction.

To understand the forces shaping mixed reality, this research framework starts by utilizing the functional perspective of small group research (Poole, Hollingshead, McGrath, Moreland, & Rohrbaugh, 2004; Wittenbaum et al., 2004). The purpose of the functional perspective is to understand how goal-oriented groups work together with the aim of explaining, predicting, and improving group effectiveness. As a point of contrast, other key perspectives in small group research include psychodynamic (e.g. Rutan & Stone, 1993) and temporal (e.g. Arrow, Poole, Henry, Wheelan, & Moreland, 2004) perspectives which examine the emotional underpinnings of group dynamics and the changes that occur in groups over time, respectively.

The functional perspective has been applied to a variety of topics in small group research. For example, theories that fall under the functional perspective include the reasons why groupthink can occur, the task setting and individual motivations for effective group decision making, and understanding the different kinds of conflict that occur in teams (Wittenbaum et al., 2004). The commonality that binds these different research topics under the functional perspective is the conceptualization of group effectiveness in terms of a set of inputs, processes, and outputs.

The functional perspective is the most appropriate theoretical starting point for this research because it allows for a multitude of different constructs to be considered; these constructs are organized as a set of relevant inputs, processes, and outputs (IPO). Inputs to the model are characteristics about the team itself. The processes of interest are any factors that occur while the group works together, and outputs are the outcomes to be measured. In this research, the inputs, processes, and outputs are defined below in Table 2; each of the constructs listed will be reviewed in-depth in the literature review following the definitional overview of the model.

Inputs	Processes	Outputs
Meeting Type Polychronicity Cohesion Beliefs	Technology Multitasking Copresence Management	Perceived Productivity Meeting Satisfaction

Table 2: Input-Process-Output Model of Mixed Reality.

Definitions of IPO Research Constructs

In this section, each of the IPO constructs is defined and an explanation is given for how these constructs interrelate. Following this introduction to the model, the literature review pursues an in-depth analysis of these constructs in relation to prior research as it pertains to mixed reality.

Meeting Type: The format of the meeting based on its main purpose and attendees. The main meeting types for information workers are: staff meetings, sales/pitch meetings, internal project meetings, external project meetings and company-wide meetings. See Chapter 3 for the pilot study which identified these common meeting types.

Polychronicity: An individual's preference and belief that multitasking is the best way to accomplish multiple tasks.

Cohesion Beliefs: An individual's beliefs about the importance of positive group member relationships and the individual's commitment to the task.

Technology Multitasking: The type of work tasks for which an individual uses portable technologies for during a meeting (either "private" tasks or group tasks).

Copresence Management: The verbal and nonverbal signals individuals using technology send toward others to indicate that they are attending to the collocated group (in-room copresence). And, the verbal and nonverbal signals sent to electronic communication partners to indicate availability for interaction (electronic copresence).

Perceived Productivity: The subjective assessment individuals have toward how productive they felt during the meeting.

Meeting Satisfaction: The subjective assessment individuals have toward how well their time was used during the meeting.

The IPO framework is outlined in Figure 1 and each of the seven constructs defined briefly above will be given additional explanation and consideration in the following sections.

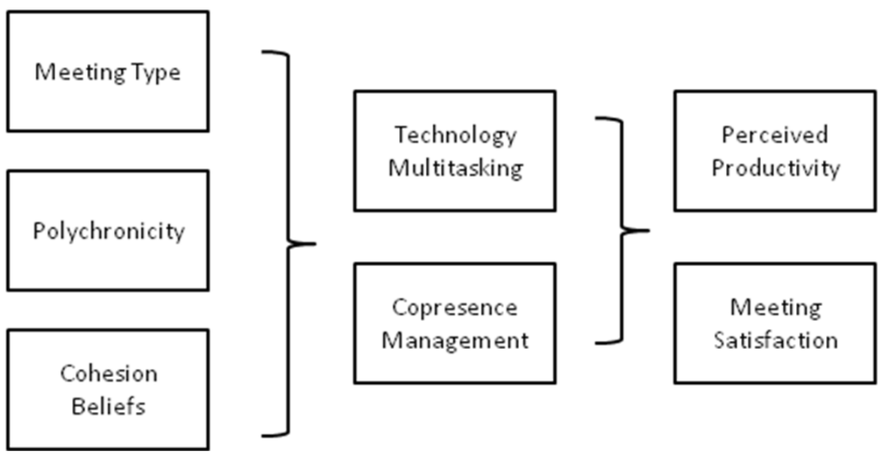

Figure 1: Conceptual Model for Mixed Reality.

Research has demonstrated that common meeting types exist across various organizations (Volkema & Niederman, 1995) and that groups develop norms that lead to a set of typical and expected behaviors for people in given situations (Feldman, 1984). Research has also shown that groups have specific ways in which they expect technologies to be used (Postmes, Spears, & Lea, 2000). The first part of the conceptual model is based on these general findings that, depending on the type of meeting, we expect there to be a group norm for how technology is used. However, as adaptive structuration theory models, group norms are not the only influence for how technologies are used in organizations (Orlikowski, 2000). Individuals have their own motivations and expectations which can differ from group norms, and it is the interplay between the individual and group in specific work contexts which impacts technology use.

There are two parts to the structurational model that shape how technologies are used in practice: embodied structures and user appropriation. Embodied structures are features of the technology designed by the originators of the tool. Designers have intentions and expectations for how the technology is supposed to be used from their perspective; for example only allowing a particular sequence of actions to be taken by the user in a given state. These structures are designed to guide users into a system that matches organizational rules and operating procedures.

The second part of the structurational model accounts for how users decide to change, bypass or ignore these technology structures. The embodied structures designed into the technology are modified by users through practice; despite the expectations of use built into the system by designers, users will find ways to make technology better match their individual needs. The role of context shapes this appropriation too—users do not use the same technology in the same way across situations. Technology use is re-contextualized as situations change, and this idea works well for modeling mixed reality since different meeting types will likely impact why and how someone decides to use technology.

Depending on the type of meeting attended, some individuals may decide to manage their level of copresence so that they appear more available to others in the same room—for example, individuals who typically use technology may not to do so in certain meeting types where they believe it may signal rudeness or not paying attention. The conceptual model proposes that individuals who have positive cohesion beliefs are more likely to manage copresence in a way that demonstrates that their focus of attention is with the collocated group activity.

Cohesion beliefs in this model are defined as a combination of task commitment and positive interpersonal interactions. When group members are highly committed to the group task they may use technology for private work less because they are focusing their attention on the group task. And, when individuals value positive interpersonal interactions with other group members, this may result in managing copresence with other group members in ways that signal they are available for interaction.

Individuals using technology in group meetings may try to manage how available they appear to others who might contact them electronically (e.g. via instant messaging or e-mail). Does copresence management occur with electronic others by changing electronic status messages (e.g. "away from desk" availability status in instant messaging)? Some evidence from McCarthy et al. (2004) suggests that people announce to others during electronic communication that they will be focusing their attention elsewhere (so online messages will not be responded to as quickly).

During mixed reality meetings, technology may be used for either private work (work that does not immediately pertain to the group task) or in ways that assist with the goals of the group. Extrapolating from the research on polychronicity and task satisfaction (Cotte & Ratneshwar, 1999), individuals who are polychronic should be more satisfied during meetings because they can accomplish other work simultaneously. However, other group members (who are not using technology) in the meeting may not attribute the same positive value toward being in a meeting and multitasking, and they may rate their satisfaction with the meeting lower due to other people's technology use. In the following sub-sections, each of the conceptual model constructs is explained in more depth with supporting literature.

INPUT: MEETING TYPES

Intuitively we know that our interactions with other people changes depending on the situational context. In some organizational meetings, individuals may be compelled to change their behavior in such a way to be more attentive to the group's needs. These behavioral changes may occur, for example, because outsiders are present and a "good impression" is desired. Therefore, the conceptual model begins with the idea that the type of meeting has an effect on how someone decides to use technology. Even when outsiders are not present, group members who technology multitask may still want to demonstrate to their meeting peers that they are actively engaged in the meeting. Furthermore, the type of meeting may be an indicator of how relevant the meeting is to the user; and less relevant meeting segments may be more prone to technology multitasking.

Defining Meeting Types

Organizations have various kinds of meetings that differ in their purpose, attendance, and behavioral expectations. However, across organizations there are stereotypical meeting types that are common. Research by Volkema & Niederman (1995) defines six main meeting formats as shown in Figure 2. Each meeting format is distinguished by its overarching purpose and communication structure, but the formats are not mutually exclusive; for example a Forum meeting type can occur in conjunction with Announcements (or any other possible combination of the types).

The meeting formats defined by Volkema & Niederman manifest either a primarily hierarchical or organic communication structure. Hierarchical communication structures are formal, meaning there is a specific agenda or protocol as to who speaks when, whereas in an organic communication structure the meeting discussion is free-form and people contribute and talk as is natural to the discussion at hand. Research on corporate meeting types by Romano, Jr. & Nunamaker, Jr. (2001) found that 66% of meeting types involve active listening and discussion by its members, which would be an organic structure (the other 34% of meeting types falling into a hierarchical format). People naturally think of the meetings they attend in terms of prototypical types—in a pilot study of office worker descriptions of meeting types (Kleinman, 2007) interviewees were asked to describe the different kinds of meetings attended and all participants without prompting responded to the question by organizing their meetings into types.

1. **Demonstration/presentation** - Explain, present or sell a product, service, project, or idea. Information flows from an individual or team to a target audience.

2. **Brainstorming/problem-solving** - Analyze a specific problem, generate new ideas or concepts, or solve a problem. Singular focus, but decentralized structure in that people are expected to communicate back and forth with each other.

3. **Ceremonial** - To honor individual(s) or an event. It may be unstructured like a party in the break room or highly formalized with a specific award presentation structure.

4. **Announcements/general orientation** - Share information on a diversity of topics of interest to most or all group members. Usually centralized, information from an individual-team to a target audience.

5. **Forum** - Various members of the group contribute to a single agenda, followed by a decentralized interaction among the entire group. See also department or staff meetings.

6. **Round robin meetings** - Each person presents a progress report of their own agenda which may be accomplishments, things they have been working on, or bringing up problems. When each person has finished presenting their agenda, the meeting is over.

Figure 2: Six Meeting Format Types (Volkema & Niederman, 1995).

When we consider the type of meeting that technology multitasking will likely have the most impact, it is project meetings (as opposed to informal social meetings, large "all-hands" company-wide meetings, and general status update meetings). Project meetings (similar to Volkema & Niederman's Forum meeting type) are characterized by a set of individuals (often in differing job roles) united by a common work goal. In project meetings, communication and collaboration between group members is essential to the success of the meeting, therefore if some group members are distracted by technology use, this has the potential to impact how well the group works together.

A survey conducted with 165 executive MBA students by Kinney & Panko (1996) summarized data on the characteristics of project meetings: they have a mean size of 7.7 people, with a median of 7, and a range of 3 to 16 attendees. The duration of the projects is a mean of 4.6 months and there is a mean of 16.5 meetings held per project. The implication of these general characteristics about project meetings for mixed reality research is that norms will develop over time because of the project length and that meetings are an essential feature for how the project proceeds.

Group Norms and Meeting Type

For each meeting type, there will be both implicit and explicit rules developed by each group for how the meeting proceeds in terms of behavioral expectations. People have *scripts* that they develop which are internal guidelines for how they decide to behave in particular settings. Originating from the work of cognitive psychologists, Schank & Abelson (1977), the concept of a schema explains the cognitive mechanism for how people understand and give meaning to social information or social situations. Scripts are structured patterns of regular behaviors in a given context which allow people to more easily understand social situations and serve as a guide to what is considered appropriate behavior in that context. Script theory has been applied by Gioia & Poole (1984) to organizational settings to explain how group meetings, performance appraisals, and other common work interactions follow familiar and predictable patterns that enable people to navigate meaning and reference. In their framework, they suggest that script theory needs to account for people's perceptions of their own behavior in addition to the person's interpretation of the same behaviors by others. These rules (or scripts) for behavior are often described by other researchers as norms.

When people become socialized into groups, they learn to identify with the group through interactions with other members. When this socialization is successful, people's sense of self begins to identify with the group and they act in ways that are considered appropriate for the group's norms (Cotte & Ratneshwar, 1999). When people fail to agree with group norms, they may be obliged to follow the norm regardless, which is called compliance (Fulk, 1993). Research has found that people comply with norms for a number of reasons such as avoiding negative evaluations. Turner, Grube, Tinsley, Lee, & O'Pell (2006) found support for employee performance evaluations being linked to the organizational norms for technology use. In a survey by Turner et al., employees who received a large number of e-mails but did not respond to these messages were rated lower in their performance evaluation (where the organizational norm valued prompt replies to electronic communication). When group members internalize norms, they accept and incorporate these norms into their own attitudes and behaviors. However, in other cases, compliance occurs when individuals are cognizant of the norms and do not internally accept them, but follow the norms anyway to maintain harmony within the group.

Group norms are expectations about behavior that influence how each member regulates her or his actions in the group. For example, in many public social settings the norm for mobile phones is that the ringing feature should be turned-off or very quiet. This norm can be made explicit through physical signage or auditory messages that prompt people to “Please silence your mobile phone.” Implicitly, this norm is reinforced when someone becomes visibly embarrassed by the ringing of his or her phone, or if another person projects an unkind glance toward someone’s ringing phone. Every group has its own norms for what types of technology use are acceptable for a given meeting type, and these norms can impact group productivity because it influences how members behave (Feldman, 1984). In the example, if norms were not followed about mobile phones ringing, interruptions could occur so frequently in a face-to-face meeting as to make it impossible to communicate effectively. While this example could be considered the extreme, there is anecdotal evidence in popular business articles (e.g. “Minding the Meeting, or Your Computer?” in the New York Times, 2007), that discuss the widespread sense of annoyance and rudeness that using a laptop can cause in a group meeting.

Group norms are an essential part to understanding how members regulate technology use in mixed reality settings, but these norms can be difficult to identify because groups do not “establish or enforce norms about every conceivable situation” (Feldman, 1984, p. 47). Additionally, these norms for technology use can be ambiguous because technologies operate in multiple modes—someone “surfing” the web for movie show times is potentially quite different than this same person looking up information on the web relevant to what the group is discussing. Given the mutability of a technology’s functionality, other factors must determine the ways in which technology is understood as a group norm.

Feldman describes four main ways in which most group norms develop:

(1) explicit statements by supervisors or co-workers (e.g. before the meeting begins, the meeting leader asks everyone to turn off mobile phones)

(2) critical events in the group's history (e.g. someone is publicly reprimanded for technology multitasking in the meeting, or a memo is sent to everyone in the company outlining a technology use policy for meetings)

(3) primacy (the first behavior pattern that emerges in a group sets the expectation)

(4) carry-over behaviors from past situations (what we've experienced from prior settings influences our expectations of appropriate behavior)

Given that the norms for technology use may be more subtle than just "it's used in meetings or it's not," Ryan's (2006) concept of *information handling* helps identify how social expectations impact technology use. In Ryan's model, social rules can override technical possibility in the realm of information exchange—he gives as an example that a wedding invitation is not sent via e-mail, even though it is technically feasible to do so. The social norms of our culture prescribe what the proper form of communication should be and for what kinds of information it is acceptable to share electronically.

Ryan posits that there is an information order for how information is acquired, stored, concealed and disseminated and for how this information is distributed across collective, public and private knowledge sources. Individuals and organizations make decisions about how to share information and this occurs through a socialization process that creates these norms. The implication of these norms for mixed reality is that the social order may override what individuals want to do and the technological possibilities.

This section on meeting types identified the main organizational meeting formats and how group norms for technology multitasking are anticipated to differ across these types. In the next section, the individual characteristic of polychronicity is defined and its role on shaping technology multitasking is described.

INPUT: POLYCHRONICITY

While the type of meeting may play a strong role in determining how technology multitasking occurs, individual motivations may have an equally relevant role. In the conceptual model, polychronicity is proposed as an individual factor that will also determine if and how technology is used during meetings. There is an emerging body of research which suggests that people who prefer to multitask as their work style (high polychronicity) are more likely to use technology in meetings and evaluate others who multitask in this way more favorably.

Defining Polychronicity

In mixed reality, individuals who technology multitask can be considered to have a polychronic work style. Polychronicity is a term that describes people who prefer to work on multiple activities or tasks simultaneously (Kaufman-Scarborough & Lindquist, 1999). A person who is oriented toward polychronicity perceives time as occurring in such a way that different activities can be layered simultaneously. Conversely, a monochronic individual is one who perceives time as discrete segments which are then ideally allocated to one activity per given segment.

Individuals who prefer to work in a monochronic fashion will typically set up activities to avoid interruptions (Kaufman-Scarborough & Lindquist, 1999). The monochronic-polychronic scale is a continuum—an individual's preference for a particular time orientation is not only monochronic or polychronic, people can fall into a middle range too. Lindquist & Kaufman-Scarborough's (2007) survey of 375 non-students in a Midwestern US city found a mean value of 4.72 for polychronicity orientation on a 1 to 7 Likert scale. A score closer to 1 indicated a preference for monochronic behavior and a score closer to 7 a preference for polychronicity.

Cotte & Ratneshwar (1999) propose that an individual's polychronicity/monochronicity orientation is derived primarily from the dominant culture one lives in, but social and work groups and individual preferences also shape one's attitude toward polychronicity. The temporal pacing of work impacts people's attitudes and how they schedule and manage multiple activities at the same time. In most workplaces people work polychronically, especially when using a computer which allows for multiple work tasks to be available simultaneously on a single screen. However, while people often work in a polychronic manner, people do not attribute the same value toward working in this way. Cotte & Ratneshwar propose that some people will feel negatively toward working polychronically; they will feel stressed and perceive that the quality of their work is less because they cannot focus methodically on one thing at a time. Other people, however, will feel that polychronic work is efficient and allows for a smoother and more accomplished work day from which they derive satisfaction.

Individual attitudes toward polychronicity have been shown to impact how groups perceive and use time. Waller, Giambatista, & Zellmer-Bruhn (1999) explain how individual perceptions toward time use act as a pacing mechanism or catalyst for group activities. Having different perceptions toward time can subsequently impact how groups work together. In an experimental study using MBA students assigned to different "time urgency" project conditions, Waller et al. observed how individual group members reacted to changes in the experiment's project deadline by coding verbal statements about time and the frequency of looking at a clock or watch. Waller et al. found that individuals in group settings can act as catalysts to move a meeting along by comments such as "Okay, let's push through this and get to the next thing on the agenda." These types of comments can play a role in how the group completes their work. Similarly, for mixed reality, one might expect that when individuals multitasking with technology are perceived as the standard, that others may feel that working polychronically is the "right way" to work, and therefore may change their orientation toward polychronicity.

Measurement of Polychronicity

There have been multiple efforts to create a reliable measure of polychronicity as shown in Table 3.

Polychronicity Scale	Citation	Cronbach's alpha[1]
Polychronic Attitude Index (PAI)	Kaufman et al., 1991	.67
Polychronic Attitude Index 3 (PAI3)	Kaufman-Scarborough & Lindquist, 1999	.82
Modified Polychronic Attitude Index (MPAI)	Lindquist et al., 2001	.88
Inventory of Polychronic Values (IPV)	Bluedorn et al., 1999	.86
Monochronic Work Behavior	Frei et al., 1999	.50
Polychronic-Monochronic Tendency (PMTS)	Lindquist & Kaufman-Scarborough, 2007	.93
[1] Nunnally (1978) recommends a Cronbach's alpha value of at least .70 for reliability		

Table 3: Polychronicity Scales and Associated Reliability Score.

The initial Polychronic Attitude Index (PAI) scale by Kaufman, Lane, & Lindquist (1991) was developed using a survey of households where at least one adult was employed full time. The Kaufman et al. study asked people about their attitudes toward performing multiple tasks simultaneously, which were developed into the PAI scale (shown below). The questionnaire asked participants about their preferences for performing multiple activities (such as eating while driving, doing something else while watching television, and so forth), with the goal of understanding if a person's attitude toward polychronicity could be linked to the likelihood they would manage their everyday activities in a manner reflecting this attitude.

Polychronic Attitude Index (PAI) Scale

1) I do not like to juggle several activities at the same time
2) People should not try to do many things at once
3) When I sit down at my desk, I work on one project at a time
4) I am comfortable doing several things at the same time

The sample used to develop the PAI scale consisted of households from an urban residential neighborhood in the United States. In-person survey data was collected from every fifth household in designated neighborhood clusters, with final data collection consisting of 310 questionnaires from 42% male, 58% female respondents. About sixty-three per cent (63.2%) of the respondents worked at least 40 hours per week, median age fell in the 26-35 years old range, and median income was in the $45,000-$49,000 range. This initial test of the PAI scale resulted in a .67 reliability coefficient, which is below the recommended .70 Cronbach's alpha value.

Further refinement of the PAI occurred in Kaufman-Scarborough & Lindquist (1999) using a similar population and sampling method, and the Cronbach's alpha value was improved when item number 3 was removed from the scale. PAI-3 (as it was called in this iteration) omitted question 3 because the wording about "sitting at a desk" seemed to bias the results in such a way that participants did not understand or believe that this question was relevant to their personal experience. When this question was removed, the reliability of the PAI-3 was .87, well above the recommended value.

Lindquist, Knieling, & Kaufman-Scarborough (2001) then modified the PAI-3 to test whether Japanese students perceive and use time differently than US students in a cross-cultural survey of polychronicity. Fifty-two US students at the same university volunteered to complete the modified PAI-3 questionnaire as part of a classroom activity, and 68 Japanese students from this same university were recruited via activity clubs and student centers and completed the questionnaire with an incentive. The three item scale used for the new version of PAI-3 (now called the MPAI) were:

Modified Polychronic Attitude Index (MPAI)

1) I like to juggle several activities at the same time
2) People should try to do many activities at once
3) I am comfortable doing several activities at the same time

The first two statements were changed from negative to positive when compared to the earlier version of PAI/PAI-3. Furthermore, the word "things" was changed to "activities" in the first two items to provide consistency in wording for the respondents. While the small and non-random sample makes the generalizability of this study weak, the authors did find statistically significant support that Japanese students exhibit a preference for working monochronically. These changes to the scale resulted in a Cronbach's alpha value of .88.

Other researchers have worked on the PAI scale in order to improve its reliability. Bluedorn, Kalliath, Strube, & Martin (1999) created the Inventory of Polychronic Values (IPV) scale which aimed to more reliably assess polychronicity compared to the original PAI. An initial IPV scale was developed using the responses from 89% of the population of employees who worked at a medium sized bank in the United States (the sample was

205 respondents across all organizational levels within the bank). This initial version of the IPV was then further refined to improve internal consistency by adding additional questions and testing a new sample of 115 college business majors. The resulting IPV scale had a Cronbach's alpha value of .86.

Inventory of Polychronic Values Scale

1) I like to juggle several activities at the same time
2) I would rather complete an entire project every day than complete parts of several projects
3) I believe people should try to do many things at once
4) When I work by myself, I usually work on one project at a time
5) I prefer to do one thing at a time
6) I believe people do their best work when they have many tasks to complete
7) I believe it is best to complete one task before beginning another
8) I believe it is best for people to be given several tasks and assignments to perform
9) I seldom like to work on more than a single task or assignment at the same time
10) I would rather complete parts of several projects every day than complete an entire project

A different approach to assessing polychronicity was completed by Frei, Racicot, & Travagline (1999) who created a scale with the following questions on a 6-point Likert scale (shown below). Frei et al.'s approach differed from the previous scale just discussed because the questions ask people about actual behaviors and not just attitudes.

Monochronic Work Behavior

1) I use call forwarding when I am in a meeting
2) I use a do not disturb sign when I am in a meeting
3) I work with my office door open (reverse scored)
4) I have the department secretary screen my calls

The purpose of this scale was to test if people who were prone to Type A behavior were more likely to engage in monochronic work behaviors. Type A behavior occurs in persons who are typically described as obsessed with time in that they are punctual, focused on deadlines and are impatient. More broadly, Type As are very achievement oriented, set ambitious goals and expectations, and are highly competitive. The authors wanted to examine the relationship between Type A behavior traits and whether this personality type took specific steps to minimize distractions while working (the monochronic work behavior). In this study, a sample of 147 college professors at a technical college in the United States was used to create a scale for monochronic work behaviors. Frei et al. asked psychology professors in their department "What do you do to minimize interruptions when you are working?" The responses to this question resulted in the 4-item scale above. In this study, the Cronbach's alpha value was .50 indicating that the Monochronic Work Behavior scale is not the most promising measurement for polychronicity.

In terms of the boundary conditions for polychronicity, the PAI (and its later iterations) has been used to measure polychronicity across different contexts including students use of time (Lindquist et al., 2001), the banking industry (Bluedorn, Kaufman, & Lane, 1992) and as a construct related to culture and gender (Manrai & Manrai, 1995). The IPV, on the other hand, is more specifically linked to work tasks and workplace behaviors as reflected in the wording of its questions. The development of the Polychronic-Monochronic Tendency Scale (Lindquist & Kaufman-Scarborough, 2007) is a recent effort to define polychronicity as a trait independent of context.

To develop the Polychronic-Monochronic Tendency Scale (PMTS), the authors created a survey instrument of 50 statements related to time-use and gathered responses from 256 adults (50% male, 50% female). The results from this survey were used to create the PMTS shown below, which was then further tested for internal consistency and discriminant validity. The Cronbach's alpha value for the PMTS is .93.

Polychronic-Monochronic Tendency Scale (PMTS)
1) I prefer to do two or more activities at the same time
2) I typically do two or more activities at the same time
3) Doing two or more activities at the same time is the most efficient way to use my time
4) I am comfortable doing more than one activity at the same time
5) I like to juggle two or more activities at the same time

Based on these studies, it has been demonstrated that polychronicity is a measurable set of attitudes that people hold in regards to multitasking. The scales with the highest Cronbach's alpha values were the PMTS, PAI-3, MPAI, and IPV. The next sub-section will describe the research on polychronicity as it relates to technology multitasking.

Polychronicity and Technology Use

The use of polychronicity to study individual differences in technology use is a relatively new area of focus in organizational behavior research. Bell, Compeau, & Olivera (2005) proposed a call for research that included polychronicity as a construct for studying technology multitasking. They created a conceptual model and hypothesized that people who multitask with technology are higher in polychronicity. Additionally, they proposed that when group members are high in polychronicity, they will view other group members as more competent, dedicated, and socially attractive when they multitask with technology too.

Lee, Tan, & Hameed (2005) investigated if polychronicity impacted time spent using the Internet and perceptions of Internet use with a telephone survey based on responses from randomly dialed Singaporean residents. The authors' theorized that the ability to multitask with the Internet is suited toward polychronic individuals who would also have a more positive assessment on the use of it (similar to the ideas of Bell et al.). In the Singapore study, the original Kaufman et al. (1991) PAI scale was used to measure polychronicity with a slight modification to question 3 (the desk question) changing it to "[I] work on one project at a time." This modification to the scale did not change the reliability coefficient (both are .67).

The authors did not find a significant relationship between polychronicity level (categorized in this study as low, medium, or high) and time spent on the Internet. Unfortunately, time spent on the Internet may not be the best variable to reflect Internet use since skill level may cause an interaction effect. Furthermore, it is likely that monochronic individuals can spend just as much time on the Internet (perhaps using the Internet serially in a focused manner). Despite not finding a correlation between Internet use and polychronicity, positive perceptions about Internet use were significantly correlated to high polychronicity levels. While the use of polychronicity to assess differences in technology use is still in its beginning stages, there has been some evidence to demonstrate that the polychronicity construct has merit in understanding mixed reality. For example, Ophir, Nass, & Wagner (2009) found that people who prefer to multitask with multiple types of media have a difficult time ignoring distracting information compared to people who avoid multitasking. This research will aim to better assess if and how high polychronicity individuals use technology differently than those with low or medium polychronicity.

INPUT: COHESION BELIEFS

In the conceptual model, cohesion beliefs are considered as another individual-level variable that impacts technology multitasking and copresence management. In this research, cohesion beliefs are defined on two dimensions: the importance of positive interpersonal relationships between group members and commitment to the task. While there have been numerous definitions for cohesion which will be further explored in the following sections, the general consensus amongst small group researchers (see Braaten, 1991 for a meta-review of cohesion dimensions) is that cohesion is a multidimensional construct involving a social factor (social liking) and a task factor (task commitment). For mixed reality, this means that individuals who have positive beliefs about the importance of group cohesion may spend less time using technology for private tasks and if they do use technology they will manage their level of copresence to reflect availability and attention toward the collocated group. Cohesion is an important construct for assessing group dynamics because high levels of cohesion are related to increased communication amongst members, greater task commitment and better performance (e.g. Evans & Dion, 1991 and Shaw, 1983).

Defining & Measuring Group Cohesion

What exactly do researchers mean when they use the construct of cohesion? While at first blush it seems obvious that cohesion is a property of the group that reflects how well the group "sticks together," this characterization lacks precision in terms of the mechanisms by which cohesion is achieved and what exactly it means to be bonded to a group. Nevertheless, one of the most cited definitions for cohesion is that it's "the resultant of all the forces acting on members to remain in the group" (Festinger, 1950). Festinger and his colleagues originally developed their definition for cohesion by studying housing complexes and examining communication patterns to see if there was a relationship between cohesiveness of a group and the amount of influence members exhibited. One of the ways they operationalized cohesion was by calculating the number of friendships within someone's immediate housing unit in relation to the friendships held across all the housing units—the more friendship links that were within the same unit, the higher the cohesion score.

There are two main criticisms of Festinger's conceptualization of cohesion. First, it is unclear what the "forces" are that contribute to or reduce cohesion, and second the method for operationalizing cohesion does not follow from its definition. This second criticism is important to consider further since it reflects a long-standing problem in cohesion research which is the tendency to use individual-level measurements for a group-level phenomenon (Evans & Jarvis, 1980). For example, Libo (1953) and Israel (1956) asked individuals to rate their "attraction-to-group" on a given Likert scale, and then took these individual scores and pooled them to calculate a mean level of group cohesiveness. The problem with aggregating individual scores is that it does not accurately reflect the group unless the individual scores are checked for agreement, meaning that the individual scores are relatively homogenous and therefore can be extrapolated to reflect the group's cohesion level (Gully, Devine, & Whitney, 1995). Furthermore, these pooled scores for cohesion tend to view cohesion as a unidimensional construct which has traditionally only considered the social aspects of cohesion and are only useful for specific types of groups (Mudrack, 1989).

To overcome these issues with defining and operationalizing cohesion, Carron, Widmeyer, & Brawley (1985) developed a multidimensional model for the mechanisms involved in cohesion and termed it the Group Environment Questionnaire. Carron et al. define cohesion as "a dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs." The important facet of this definition is that cohesion is organized across two areas of focus: individual-group and social-task. This breakdown into four components (shown on next page) reflects cohesion across not only individual opinions about the task and social liking of the group, but also perceptions of how the group is working together.

The four dimensions of cohesion by Carron et al. (1985):

- *Individual Attraction Task*
  - How attractive the group task is to the individual
- *Individual Attraction Social*
  - The individual's attraction to want to be part of the group
- *Group Integration Task*
  - Individual beliefs about the group's willingness to achieve the group goal
- *Group Integration Social*
  - Individual perceptions about how close and bonded the group is as a whole

While the model and questionnaire proposed by Carron et al. was developed for sports teams, it has been considered one of the most promising efforts for assessing cohesion in other types of groups (Evans & Dion, 1991; Cota, Evans, Dion, Kilik, & Longman, 1995). In Carron & Brawley (2000) a process to adapt the Group Environment Questionnaire to other contexts is described, specifically by changing wording and eliminating non-relevant questions and then pilot testing the revised questionnaire to ensure that construct validity is maintained. The Group Environment Questionnaire is shown in Table 4; for the purposes of this review the questions are grouped into their sub-components (e.g. Individual Attraction-Social) but the original ordering of the survey questions is shown by the numbers (1, 2, 3…18).

INDIVIDUAL ATTRACTION-SOCIAL	INDIVIDUAL ATTRACTION-TASK
1. I do not enjoy being a part of the social activities of this team. 3. I am not going to miss the members of this team when the season ends. 5. Some of my best friends are on this team. 7. I enjoy other parties more than team parties. 9. For me this team is one of the most important social groups to which I belong.	2. I'm not happy with the amount of playing time I get. 4. I'm unhappy with my team's level of desire to win. 6. This team does not give me enough opportunities to improve my personal performance. 8. I do not like the style of play on this team.
GROUP INTEGRATION-SOCIAL	**GROUP INTEGRATION-TASK**
11. Members of our team would rather go out on their own than together as a team. 13. Our team members rarely party together. 15. Our team would like to spend time together in the off season. 17. Members of our team do not stick together outside of practices and games.	12. We all take responsibility for any loss or poor performance by our team. 10. Our team is united in trying to reach its goals for performance. 14. Our team members have conflicting aspirations for the team's performance. 16. If members of our team have problems in practice, everyone wants to help them so we can get back together again. 18. Our team members do not communicate freely about each athlete's responsibilities during competition or practice.

Table 4: Group Environment Questionnaire (Carron et al., 1985).

This section provided an overview of the varying definitions for cohesion. The rationale for defining cohesion as a multidimensional construct based on social liking and task commitment was explained. In the next section, the use of cohesion for mixed reality is reviewed.

Cohesion in Mixed Reality Research

This research will use the definition of cohesion that encompasses both social and task dimensions. Using these two dimensions for cohesion provides a foundational construct for the interplay between how well a work team communicates, develops norms for technology use, and performs as a work group. The specific operationalization for cohesion in this work is described in Chapter 5. When an individual has positive beliefs about cohesion, members should hypothetically be less inclined to use technology because they feel more compelled to work with collocated others.

In a group where members are emotionally bonded, social cohesion will be strong. However, should the group perform poorly on tasks one would expect cohesion to decrease (e.g. Ruder & Gill, 1982). On the other hand, a group where nobody feels personally connected to each other could perform quite well on tasks, and team members could feel cohesion based on the task dimension alone (imagine a distributed work team that does not meet frequently yet has well defined roles and responsibilities that all group members uphold). In other words, there is a degree of independence between social and task cohesion but it is not yet clear how cohesion will be impacted by these dimensions in mixed reality.

Hogg (1987) found that cohesion is increased by the mere act of assembling people together. And, as group members spend more time together, cohesion is increased (Manning & Fullerton, 1988). These findings on the ease in which cohesion is produced indicate that working with others produces bonds that impact how people behave in a group setting. Emotions also play a role in the development of cohesion as group members who like each other also rate the group as more cohesive (Piper, Marrache, Lacroix, Richardsen, & Jones, 1983). Also, groups that are seen as rewarding to its members have stronger cohesion (Ruder & Gill, 1982 and Stokes, 1983). Members in cohesive groups have higher participation rates, convince others to join the group, and resist attempts to disrupt the group. Highly cohesive groups are also more likely to conform to group norms.

Despite the numerous findings about the desirable outcomes produced by cohesive groups, the mechanisms for increasing cohesion remain elusive. Does social cohesion lead to increased communication levels and higher member satisfaction, or is social cohesion a construct that reflects these attributes? Research has not favored one interpretation over another; cohesion is represented throughout the literature as both a multidimensional phenomenon and as a latent construct with multiple indicators (Friedkin, 2004). However, despite the circularity in defining cohesion there are common features to cohesion that can help in understanding mixed reality; highly cohesive groups have the following attributes (Shaw, 1983):

- Intra-group communication is more extensive
- Interactions are more positively oriented
- Groups exert greater influence over their members
- Groups are more effective in achieving their respective goals
- Members are usually better satisfied with the group

Based on these general findings about cohesion in groups, this research anticipates that mixed reality meetings will be impacted in the following ways. Groups in which members feel strongly bonded with other team members will moderate their technology multitasking in favor of the collocated group activity. Furthermore, in highly cohesive teams, the tasks performed with technology will support the needs of the group and reflect activities pertaining to the meeting.

PROCESS: COPRESENCE MANAGEMENT

In the previous sections, meeting type, polychronicity, and cohesion beliefs were introduced as the primary factors leading to technology multitasking in meetings and the impact on copresence was established. Copresence is considered here as a factor that influences behavioral processes in mixed reality. When people are managing copresence levels, they are actively trying to change how they are perceived by others which affect communication patterns and team member attitudes toward one another.

Defining Copresence Management

Copresence is a situational condition that occurs when individuals are "accessible, available, and subject to one another" (Goffman, 1963, p. 22). When individuals are copresent, they are able to observe each other and interact. However, copresence does not occur in the same "amount" for all situations. One can imagine a situation when you're talking to someone and they begin staring off into the distance—you're both in the same room but the amount of copresence has decreased. When individuals use verbal or nonverbal signals to change their presence level, they are managing their copresence. The management of presence is important because it signals our availability to others as to what social interactions are possible. People notice when communication partners avert their eyes and attend to a new situation, and it changes how people approach and converse amongst themselves.

When people interact with others their behaviors can be viewed as a performance where actions and communication are based on socially defined expectations that fit the given situation. This conceptualization of conversation and interaction as performance is termed the *dramaturgical perspective* which is also based on the work of Goffman. In the dramaturgical perspective of human interaction, one of the fundamental tenets is that people act in ways to guide and control other people's impression of them.

The act of controlling impressions and actions in front of others can occur in such a way that someone is "taken in by his own act" (Goffman, 1959, p. 19). However, one can also be more cognizant and cynical about the impressions one is making on others. Essentially, there exist two extremes for how people control impressions; it is either a sincere act by people where they are unaware that their actions are serving to shape interactions, or it can be more explicit and purposeful with an awareness that they are trying to control how others perceive them. In this research, the conceptual model proposes that individuals using technology extend this impression management, here called copresence management, in order to manipulate how people view their participation in the meeting activity and general status within the organization.

In Goffman's dramaturgical framework for group performances, each individual cooperates in team settings to create and maintain behaviors that promote the standards of the group. Therefore, in mixed reality meetings, we anticipate that individuals who feel cohesive with their team will present a front to others that maintains the standard that they are listening and attending to the needs of the group. However, when the group is meeting in front of an audience (such as outsiders like external clients or guests), an even "less truthful" performance occurs. In effect, people are on their best behavior in front of strangers to create an idealized impression, but when that audience disappears a more truthful performance of behavior emerges. Goffman's work provides a starting point for understanding copresence management at a macrosociological perspective. The next section reviews more specific instances of how people manage their copresence with technology.

Copresence Management with Technology

In mixed reality there are two types of copresence that users can manage: 1) copresence with those physically in the same room (in-room copresence) and 2) copresence with electronic communication partners (electronic copresence). In both instances, the socially desirable norm is to be as available as possible to the respective communication partners. These partners may be either those team members in the immediate meeting or the larger network of co-workers and clients available virtually through e-mail and instant messaging. Being available means that individuals signal to others that they are open for interaction through either verbal or non-verbal signals and attend to ongoing signals from these communication partners.

Managing copresence with electronic partners appears somewhat straightforward—one is either "on" or "off" the technology (e.g. your name appears in your coworker's instant messaging system as online or not). However, given the number of different hardware systems and communication applications, electronic copresence is not so simplistic. Chung, Zimmerman, & Forlizzi (2005) created a framework for the multiple communication channels (mobile phones, instant messaging, and e-mail being the most common) based on different communication modes (one-to-one, one-to-many) and various format supports (text, audio, and video). These authors suggest that following Goffman's framework on copresence, people will have different levels of presence that they may want to manage across the varying channels. Additionally, individuals may manage electronic copresence through less obvious social means—taking two hours to respond to an instant message (where the expectation of typical response time is within minutes) signals unavailability just as well as an "I'm away from my desk" status message.

Prior research on copresence and technology use with physically present others has mainly centered on mobile phone etiquette in public situations. Geser (2004) combined his own observations with prior literature on mobile phone usage to develop three reactions for an individual who receives a mobile phone call when collocated with someone else: flight, suspension, and persistence. With flight, the person retreats to a separate area away from the collocated others to use the technology. With suspension they remain in the same physical location yet stop communicating with the collocated others in favor of using the technology, and with persistence, both activities (using the technology and the collocated activity) continue simultaneously.

This model of three different reactions to incoming mobile phone calls assumes that the technological device is set to a mode where ringing or a vibration is felt by the user and that users always choose to attend to the technology. Given that some individuals are likely to disregard a mobile ring or vibration when in a collocated setting, copresence management must be defined beyond technological functionality to include behavioral adaptations. The fact that someone will purposefully mute (or ignore) her or his technological devices is an additional form of managing copresence, and one that favors the collocated activity.

Neither the collocated situation nor the electronic communication need always be at odds with each other; depending on the context, some users may be able to actively engage both collocated and electronic communication partners seamlessly. One setting in which the collocated and electronic activities are managed together without major disruption occurs when neither activity demands full cognitive attention. This scenario is realistic for mixed reality meetings where the user does not have to participate continuously in the collocated meeting and therefore has attentional capacity to glance at e-mails and respond to instant messages. Part of the research agenda will be to fully describe and understand how users shift their copresence across the face-to-face and electronic channels using polychronicity and cohesion beliefs as the drivers to copresence management.

In another study about public behavior with mobile technology, Koskinen & Repo (2006) investigated how people watched streaming video on mobile devices to see what steps, if any, people used to manage face during this task. By face management, the authors seek to explain how individuals want to preserve how they are judged so as to not be considered a disruption to the shared environment. Face management is slightly different than copresence in Koskinen & Repo's study since the participants were not intending to interact with physically present others; however the findings of this research are relevant for understanding how people perceive each other when technology might disrupt a shared setting.

Koskinen & Repo qualitatively analyzed face management using diary self-reports from 9 users (6 women, 3 men) who were provided mobile streaming video devices to use for one week. Participants were "encouraged to watch videos in various different situations" and record their experiences in a diary. Across all participants, 115 episodes about using the mobile video device were recorded and analyzed, averaging about 2 episodes per day and person. In their findings, avoidance was one of the methods used to manage face; some participants did not want to engender any unkind glances or other social repercussions for watching a noisy video in public, so they would watch it at a very low volume. People who did use the mobile video devices in more intrusive manners (with audible volume) reported receiving "weird" glances from bystanders. The authors also reported on deviant uses of the mobile device where people sought a thrill from using it to provoke envy or bewilderment from others. The device had karaoke videos and some users would sing along to the video music out loud and hoped that others would react in some surprised way. This study demonstrates that individuals are aware that their use of technology can attract the attention of others and that this interest can be manipulated based on how they use the technology. While the focus of this study was on face management, it highlights issues about copresence too. People understand that their use of technology has an impact on the way others perceive and interact with them. In mixed reality, we expect users will be cognizant of their copresence level and send either verbal or non-verbal indications of their availability to interact. Deviant uses of technology multitasking in mixed reality are also conceivable; for example, users may purposefully focus more attention on using technology in order to non-verbally express dissatisfaction with their team or the meeting. In the next section, ways of technology multitasking in meetings are identified and anticipated impacts are discussed.

PROCESS: TECHNOLOGY MULTITASKING

In the conceptual model, the combination of individual factors (polychronicity and cohesion beliefs) and the type of meeting are hypothesized to impact the frequency of technology multitasking in meetings. In this research, technology multitasking is defined by the type of tasks completed on the technology, either "private" or "group" tasks. Private tasks are not immediately relevant to the collocated group members such as checking e-mail, while group tasks enhance or assist with the meeting such as electronic notes. When the user is technology multitasking this may impact meeting satisfaction. If individuals are high in polychronicity they may believe that they are more productive in the meeting which leads to increased satisfaction. On the other hand, non-technology users in the meeting may perceive technology multitasking as rude or disruptive, especially if they believe the user is focusing on private tasks, therefore these members may have decreased satisfaction.

Theories and models about the reasons for technology use typically account for the user's opinion about the technology itself, such as its "perceived usefulness & ease of use" (Davis, 1989) and "communication richness" of the medium (Daft & Lengel, 1986). However, in this research, the definition for technology multitasking does not include specific features about the technology itself. In organizational work settings, most workers do not make explicit decisions about which technology or software application will be used for a given task. Instead, there are standards and practices for each organization which generally take precedence for determining how technology is used to accomplish work. In mixed reality, the reason someone selects a particular technology for multitasking is often not based on a comparison of different options available, but rather because they are used to using a given technology for a particular work task.

This dismissal of technological features is not intended to exclude functionalities that impact the research analysis. For example, if a technology does not allow someone to change their instant messaging availability status, this can influence electronic copresence management. In another example, mobile phone technologies can be more intrusive into collocated settings if someone forgets to silence the phone. Features of the technology are important—they do encourage and allow particular behaviors by users. However, for the purposes of this research on mixed reality, the definition of technology multitasking based on tasks categorized as private or group is believed to have greater relevance to the findings than an analysis based on technological features.

OUTPUT: MEETING SATISFACTION

Does meeting satisfaction differ across group members based on whether they are the primary user of technology or not? In mixed reality meetings, group members can be divided into two types: 1) the primary user(s) of technology and 2) the other people in the meeting not directly interacting with technology. Even though some members may not use technology during meetings, they are anticipated to be affected by others' use. In collocated team meetings, people are constantly assessing and monitoring their ability to interact with others and technology multitasking may interfere with traditional group communication structures.

As discussed previously in the polychronicity sub-section, it is hypothesized that individuals high in polychronicity will be less disturbed by other group members' technology multitasking. However, those who do not use technology may be bothered when others do so because they may perceive it as rude or disruptive. If individual members are dissatisfied with meetings due to different beliefs about the way technology should be used, this in turn may affect how well the group works together.

Defining Meeting Satisfaction

Meeting satisfaction is defined in the literature as a subjective assessment made by an individual that certain criteria have been met due to the meeting (Mejias, 2007). Within the concept of meeting satisfaction are two sub-components: satisfaction with outcome and satisfaction with process (Briggs, Reinig, & DeVreede, 2006). Outcome satisfaction occurs when an individual feels positive about how well the group achieves the meeting goals whereas process satisfaction focuses on an individual's feelings about how well the group worked together throughout the meeting.

In mixed reality settings, individuals may have conflicting goals; there are objectives to attain with the collocated team and potentially competing needs occurring from other work responsibilities available through technology multitasking. One of the issues with assessing meeting satisfaction in mixed reality is establishing whose goals are being met, either the individual or the group as a whole. For the purposes of this study, meeting satisfaction is viewed as unrelated to the group goals, but focused rather on individual feelings toward how well time was spent in the meeting. One of the common criticisms about organizations is that there are too many meetings and that they are a waste of time—does this belief become less meaningful due to people's abilities to transform time spent in meetings toward other work goals? Individuals who like to multitask with technology may be more satisfied in meetings because they are able to accomplish other tasks simultaneously. However, if these same individuals are in meetings where the norm does not encourage technology use, they may be less satisfied because their preferred behavior to multitask is being suppressed.

Technology multitasking also impacts others in the meeting who are not multitasking with technology. It is conceivable that group members who are not using technology will be less satisfied in meetings due to a perceived imbalance in the quality and frequency of contributions. Essentially, some group members may believe that those using technology make fewer contributions and are not paying as much attention to the meeting as non-technology using members which results in a contribution inequity. Contribution equity is positively associated with meeting satisfaction (Flanagin, Park, & Seibold, 2004). In Table 5, a matrix of meeting satisfaction outcomes is shown based on whether someone is a technology multitasker or not and the standard expectation the group holds about technology use. The development of the group's standard about appropriate technology multitasking is based on the meeting type, polychronicity level of each member and cohesion beliefs (as discussed earlier in the chapter). The following impacts to meeting satisfaction are hypothesized:

(1) Individuals who technology multitask in a meeting with a group that accepts the behavior will have increased meeting satisfaction

(2) Individuals who technology multitask in a group that does not accept the behavior will have decreased meeting satisfaction

(3) Individuals who prefer not to use technology in meetings will have decreased meeting satisfaction when the group accepts technology multitasking

(4) Individuals who prefer not to use technology in meetings will have increased meeting satisfaction when the group does not accept technology multitasking

	Group Norm Accepts Technology Multitasking	**Group Norm Does Not Accept Technology Multitasking**
Group Member Technology Multitasks	High Meeting Satisfaction	Low or Medium Meeting Satisfaction
Group Member Does Not Use Technology	Low or Medium Meeting Satisfaction	High Meeting Satisfaction

Table 5: Meeting Satisfaction Based on User Type & Group Norms

This section defined meeting satisfaction based on an individual's beliefs about how well time was utilized in group meetings. A rationale for how polychronicity levels and group norms for technology multitasking will impact satisfaction levels was presented. The next section reviews how productivity will be analyzed in mixed reality settings.

OUTPUT: PERCEIVED PRODUCTIVITY

Productivity in groups has traditionally been studied as it relates to quantifiable outputs such as number of member contributions and ideas generated, and quantity of work output (e.g. Putai, 1993 and Rosenberg & Rosenstein, 1980). However, given the nature of information work, it is difficult to measure how productive a meeting is based on metrics like these. Information work involves a series of decisions, knowledge sharing, and information creation that for large scale projects occurs over a series of months, if not years. Attempts to analyze productivity in mixed reality based on enumerable outputs are inappropriate for this research because they cannot capture the impact of technology multitasking on how well people work together.

Defining Perceived Productivity

In this research, perceived productivity is an outcome measurement defined by an individual's subjective belief about how productive he or she felt during the meeting. Since the purpose of this work is to assess how technology multitasking impacts behaviors and attitudes, a subjective metric for productivity is appropriate. Self-assessments of productivity are considered a valid measurement and have been found to correlate with quantifiable measures of productivity (Leaman & Bordass, 2000). However, similar to the discussion presented on meeting satisfaction, productivity in mixed reality may impact technology users differently than those in attendance who do not multitask.

As demonstrated by the Hawthorne studies, social factors can have a strong influence on people's productivity (Schwartzman, 1993). In the early 20th Century, at the Hawthorne Works factory in the United States, a series of experiments were conducted to identify the environmental variables that affect worker productivity. Lighting conditions was one of the variables identified as a productivity enhancement; however, once the research project was complete output levels dropped. One of the legacies from the Hawthorne studies is that the presence of outside researchers unknowingly interfered with people's normal work patterns, leading them to be more motivated during the research which temporarily raised productivity.

Similarly, in mixed reality the productivity beliefs of team members are expected to be impacted by the behaviors of individual technology users. The presence of technology multitasking may result in changes to productivity levels across all members in the group, not just those directly using the technology. Team members who are merely present in mixed reality meetings may become distracted by other's technology use leading to decreases in their perception of productivity. On the other hand, these same members may decide to increase their participation based on a belief of under-participation by those multitasking, and this could lead to increased perceived productivity.

CONCLUSION

In this literature review, seven constructs for conceptualizing our understanding of mixed reality were defined: meeting type, polychronicity, cohesion beliefs, technology multitasking, copresence management, perceived productivity, and meeting satisfaction. Prior research on these constructs was reviewed to explain the relationships and derive research questions to advance our understanding of the theoretical underpinnings of mixed reality.

The construct of meeting type was reviewed to identify common meeting structures across organizations which are associated with specific forms of communication, roles, and responsibilities. Most organizational meetings have an organic communication structure where discussion is free-form and there is not systematic turn-taking as to who speaks when. Along with these communication patterns, different meetings have expectations of behavior by its members; these behaviors are learned through social interactions with others and sometimes explicit rules for member conduct are set forth by a meeting leader. Project meetings were determined to be the meeting format where mixed reality would have the most impact because member contributions to the meeting are essential for the success of the group. These project meetings involve long term working relationships between members and rely on meetings to accomplish the larger work task.

While meeting type provides a lens for understanding group norms in mixed reality, polychronicity explains individual motivations for multitasking which may result in differences in behavior between group members. Polychronicity, one's preference for working on multiple things and the belief that this mode is the best way to accomplish work, was described as a measurable and stable trait of an individual. Multiple measurements for polychronicity have been developed and the different scales were described, with the most recent Polychronic-Monochronic Tendency scale being the most promising in terms of validity and generalizability across contexts. Polychronicity research suggests that polychronicity levels will impact people's preference for how they use technology in meetings and perceive other's use of technology.

The concept of cohesion was introduced as an additional influence on technology multitasking and its myriad of definitions were described: from a unidimensional construct reflecting attraction to the group to a multidimensional set of beliefs an individual holds in regards to both social and task dimensions of the group. Cohesion beliefs reflect how committed people are to the group task and if group members like each other; this construct is anticipated to influence how much attention an individual spends focused on the collocated group.

Copresence management was explored as a lens to the performative behaviors of people in group settings. Goffman's dramaturgical framework was presented which explains that people, in general, will act in ways to present a particular impression to others as demonstrated through their behavior and communication. This presentation of self becomes even more salient when outsiders are present which leads to an idealized impression. In terms of mixed reality, this research predicts that technology multitaskers will be cognizant that their use of technology has an impact on others' perceptions and that attempts will be made to control how people observe this multitasking.

Technology multitasking was defined based on two possible modes of interaction: the use of technology for private work and its use for group related tasks. This distinction was made to explain that the relevance of technology use in meetings is most appropriately studied as it pertains to the tension between the individual and the group, and not based on specific technological features.

The chapter concluded with a review of two outcome variables, meeting satisfaction and perceived productivity. Both constructs are subjective measurements that aim to assess how all members of a team are impacted by technology multitasking. In the next chapter, the conceptual model presented in the beginning of this chapter is formalized into research questions and a methodology is developed with additional insights obtained from a pilot study consisting of interviews with office workers.

CHAPTER 3: *RESEARCH METHODOLOGY*

INTRODUCTION

This chapter describes the research methodology employed in studying the phenomenon of mixed reality. Each phase of the process is discussed in detail and an explanation is given for why the methodology appropriately addresses the research aims and hypotheses. The development of the research instruments is presented along with an assessment of reliability and validity issues. In brief, this research utilized a multi-method approach based on qualitative fieldwork and interviews with information workers followed by a quantitative analysis from survey data. By combining different methods, a detailed description of real world behaviors and work patterns emerged from the qualitative research which was then balanced against hypotheses tested from the quantitative data.

Since mixed reality is a relatively new phenomenon, research to support this emerging area needs grounding in the rich descriptions of behavior that qualitative data can provide. An understanding of the organizational and technological context that people work in is necessary for assessing how and why behaviors occur. An individual can perform the same actions with very different reasons and outcomes depending on situational factors. However, because qualitative data are highly contextual, it is weak in generalizability to the larger population. Testing the relationships between mixed reality constructs using a quantitative approach is an equally important contribution to the research; the testable constructs allows other researchers to expand upon the ideas and further refine the conceptual model.

Research Overview

The phenomenon of mixed reality is defined as face-to-face group work in which some or all members multitask with portable technologies while simultaneously staying involved with the team meeting. In this setting, group members are engaged to varying degrees with both the immediate physical team and their own virtual tasks with technology. More specifically, the organizational meetings studied in this research are small group project meetings where there is an expectation that people are collocated for a set purpose involving knowledge sharing about work tasks that require the efforts of the entire group.

The main characteristics of small group project meetings are 1) team members are all involved in a shared work goal (e.g. developing a software product), 2) the meeting has specific information to share and/or issues to address regarding the project (typically identified in advance by the meeting leader with an agenda), and 3) the communication style is predominantly back and forth discussion between members. These project meetings are in contrast to other common forms of organizational meetings such as large "all hands" and presentation meetings where there is less expectation for participation and the meeting is typically dominated by a set of pre-determined speakers.

This research took a funnel-like approach toward investigation, meaning that the topic of mixed reality was broadly conceived in the beginning phases of research and narrowed in scope and behaviors of interest as more was learned about the phenomenon. This phased approach is depicted in Figure 3 and explained below.

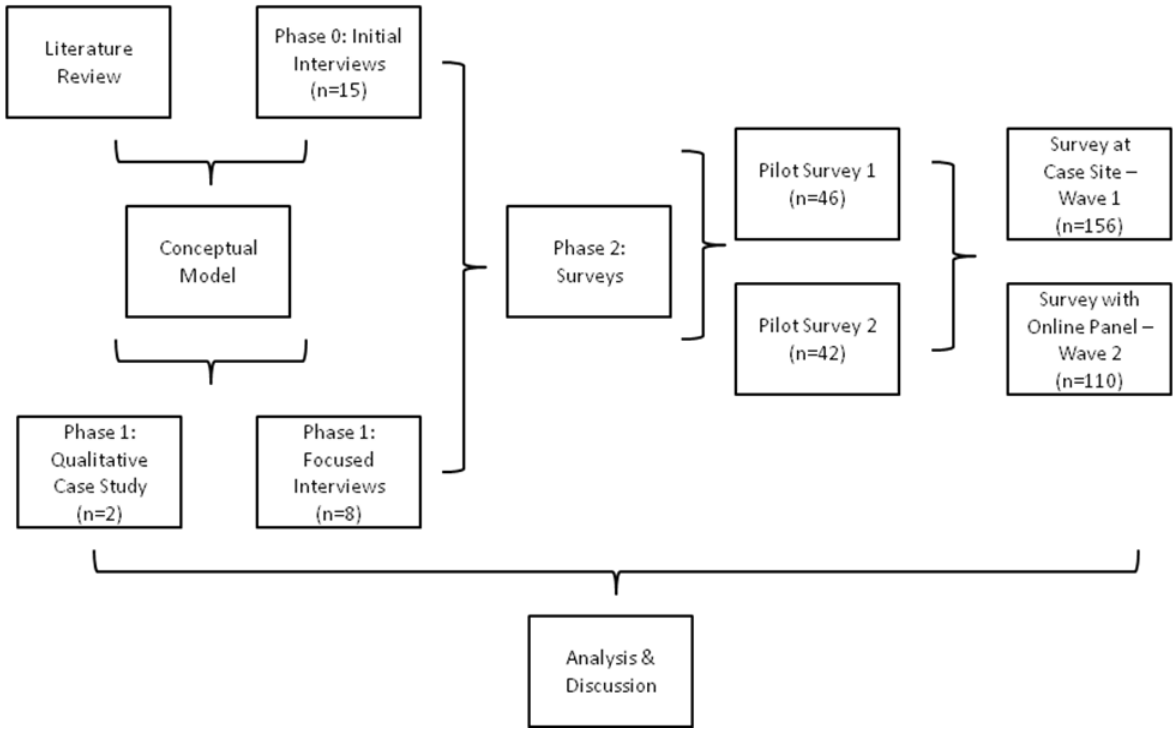

Figure 3: Overview of Research Methodology.

Phase 0 – Pilot Study of Office Workers

An initial broad investigation of the topic from which the conceptual model was developed. The pilot data aimed to respond to the following questions: In which organizations does mixed reality occur? How does this phenomenon differ across meeting types and with different types of portable technologies? Who experiences mixed reality and what are people's general reaction and opinions toward this topic?

Phase 1 – Qualitative Phase

This phase of research consisted of fieldwork with two information workers at a Fortune 500 software corporation and eight in-depth interviews with information workers from other corporations. The aim of this phase was to assess the conceptual model based on real world experiences and to generate a narrative about mixed reality.

Phase 2 – Quantitative Phase

Based on the narrative of experiences from Phase 1, hypothesis-based research questions were developed. These questions were tested in surveys starting with two pilot studies. Then, the first survey was conducted with employees at the fieldwork case site from Phase 1, and the second survey used participants from an online panel identified as information workers.

The research mixed qualitative and quantitative perspectives by gathering experiential data through interviews and observations, and then triangulating these experiences with data from survey populations. The research questions and the associated method used are shown in Table 6.

Research Questions	Phase & Method
How can we describe the phenomenon of mixed reality? In which organizations does it occur? What sorts of technologies do people multitask with?	Phase 0: Initial Interviews
P1: The context of the meeting (the meeting type) will influence the decision to multitask with technology.	Phases 1 & 2: Case Study Interviews Survey
H1: Individuals high in polychronicity will multitask with technology more than those low in polychronicity.	Phases 1 & 2: Case Study Interviews Survey
H2: Individuals who are highly cohesive with their teams will multitask less.	Phase 2: Survey
H3: Managers will multitask with technology more than non-managers.	Phase 2: Survey

H4a: Individuals high in polychronicity will manifest grater electronic copresence.	Phases 1 & 2: Case Study Survey
H4b: Individuals low in polychronicity will manifest grater in-room copresence.	Phases 1 & 2: Case Study Survey
H5: Individuals who feel cohesive with their immediate team will have greater in-room copresence.	Phases 1 & 2: Case Study Survey
H6: Individuals who feel cohesive with their team will believe that others on their team multitask appropriately.	Phase 2: Survey
H7: Individuals high in polychronicity will have higher self-efficacy with technology multitasking.	Phase 2: Survey
H8: Individuals high in polychronicity will perceive meetings as more productive when technology multitasking occurs.	Phases 1 & 2: Case Study Interviews Survey
H9: Individuals who feel cohesive with their immediate team will perceive less productivity with technology multitasking.	Phase 2: Survey

Table 6: Research Questions and Associated Method.

The next section presents Phase 0, the pilot study of initial interviews, from which methodological implications are drawn. Following the pilot study, the methodologies for Phase 1 and Phase 2 are described.

PILOT STUDY – PHASE 0: METHODOLOGY AND RESULTS

Pilot Study Methodology

In-person interviews were conducted with 15 people who work in a variety of different workplaces and attend meetings. The selection criteria included being employed full time, working in an office building (as opposed to being a telecommuter) and attending at least 4 face-to-face meetings per month. These selections resulted in a sample of 7 women and 8 men ages 25 to 58 who participated in a 30-minute interview and received $30 compensation. A summary of the participants and job roles is shown in Table 7 below.

Interviewee Job Role	**Participant Count**
Software Engineer	3
Lawyer	2
Retail Manager	2
Telephone Customer Service Agent	2
Electrical Engineer	1
Television Producer	1
Hotel Conference Management Liaison	1
Human Resources Manager	1
Mailroom Supervisor	1
Property Manager	1

Table 7: Job Roles for Pilot Study Participants.

Participants were recruited by a market research company with a database of 25,000 people in the Austin, Texas area. Using a market research firm ensured greater access to a representative sample compared to other recruiting methods such as posted flyers/advertisements, approaching strangers on the street, and the use of the investigator's personal network of friends and family. The market research firm scheduled 15 interviews for the investigator across a 2-week period. The interviews were conducted at either the interviewee's place of work, or a public coffee shop/restaurant of the interviewee's choice. The sample size of 15 interviewees is not reflective of every type of industry, technology use, or attitude about mixed reality, but this sample did provide sufficient diversity to help address the pilot study goals of ascertaining in which organizations mixed reality occurs and the general behaviors and attitudes toward technology multitasking in the workplace.

Pilot Study Interview Protocol

The pilot study interviews employed the following methodology. First, participants were introduced to the study with an explanation that the research aim was to understand how they use technology at work. The participants were informed that they did not have to answer any questions that felt too personal and the participant's confidentiality was assured. Each participant signed informed consent paperwork and then the interview began. The interviews were not electronically recorded, but the researcher did take notes by hand throughout the session. At the conclusion of the interview, the participants were paid an honorarium and were told that they could contact the researcher via e-mail or telephone if they had any further questions.

The interview protocol was semi-structured; there were four main topic areas that the researcher asked each participant. Depending on the responses to these main questions, the researcher generated more specific follow-up questions that were germane to each participant's organizational and technological experience. The four main question areas were:

1) Describe your job and the types of technologies you use in general for your job.
2) What kind of meetings do you typically attend?
3) Do you use technology in meetings? If so, when and why?
4) Do other people in your group use technology in meetings? If so, how do you feel about their technology use?

Pilot Study Data Analysis

Each interview was captured as a detailed field note resulting in 25 pages of interview summaries. The summaries were analyzed using the constant comparative technique, which is the main analytical method used in grounded theory (Auerbach &

Silverstein, 2003). This technique involved taking each relevant statement from the field notes, and systematically comparing it to all the other statements of other participants to identify commonalities and differences.

To begin this process, the field notes were reviewed by the researcher and any statement or idea relevant to the idea of mixed reality was input into a spreadsheet. From the field notes, the researcher found 68 applicable statements and these were listed along with the person (anonymized) whom it came from. The mean number of relevant statements from each participant was four, with the low being two and the high being eight statements. The number of statements attributed to a participant differed because of the diversity in the sample. Some participants never experienced mixed reality meetings, and some had jobs that did not facilitate or encourage technology use in meetings. The participants who had minimal exposure to mixed reality meetings had fewer relevant statements that addressed the research aims.

The next step in the coding process was to identify a theme to describe each of the relevant statements. As mentioned above, the guiding interview protocol was to find out which office environments experienced mixed reality, if and why people used technology in meetings, and what opinions were about the impact of technology use in meetings. Using these overarching themes, the statements were coded into specific categories to create a detailed examination of behavior and attitudes. Since this was pilot data, no formal inter-rater reliability measures were employed at this stage. However, the resulting analysis that is presented next provides a basis for the methodological choices made in the main research phases.

Pilot Study Results

Which organizations experience mixed reality?

The amount of technology available to workers was the primary indicator across participants for whether they experienced mixed reality meetings. For offices where portable technologies (e.g. laptops) were not readily available, organizational meetings were not impacted by technology multitasking, since it did not occur. Seven of the 15 respondents worked in office environments where they did not encounter any technology use in meetings. Furthermore, the respondents whose primary work tasks involved "data handling" as opposed to "knowledge work," tended not to experience mixed reality meetings since computing technologies were not used as communication or collaboration tools during meetings. Table 8 shows a count of which job roles experienced mixed reality meetings.

Interviewee Job Role	**Participant Count**	**Experience Mixed Reality? Yes**	**No**
Software Engineer	3	3	0
Lawyer	2	1	1
Retail Manager	2	1	1
Telephone Customer Service Agent	2	0	2
Electrical Engineer	1	1	0
Television Producer	1	1	0
Hotel Conference Management Liaison	1	0	1
Human Resources Manager	1	0	1
Mailroom Supervisor	1	1	0
Property Manager	1	0	1
TOTAL	**15**	**8**	**7**

Table 8: Job Role and Mixed Reality Experience.

For the 8 respondents who experienced technology multitasking, individual reactions to mixed reality differed. For Software Engineer #1, technology multitasking was the norm and accepted by others, but for Software Engineer #2, he found laptops so distracting that he had specific rules for when they could be used during the meetings he led. In a completely different work environment, the Mailroom Supervisor noted that people answered mobile phone calls in the middle of meetings and that this behavior was considered appropriate. Across all 15 participants, it was primarily the availability of laptop computers and smartphones that indicated whether mixed reality meetings were experienced.

Why multitask with technology in meetings?

For the 8 respondents who experienced mixed reality meetings, the following three reasons emerged for why they used technology during meetings.

(1) *Office Culture of Electronic Availability:* Constant communication and electronic availability were described as a necessary feature of the workplace. Participants explained that there were few boundaries for when work occurred in their life (e.g. checking work e-mail from home), and that they felt compelled to be online often. In a particularly revealing statement, the Television Producer said, "I don't even know what information I'd be missing, but I want to be online to make sure I don't miss anything." This quote expresses how the organizational culture of constant availability was an important driver for people's technology use.

(2) *Meeting Topic Not Relevant:* Participants described meetings where they had to just "sit-in" and were only asked to participate by the group as needed. This resulted in not wanting to waste time, so laptops were used to alleviate boredom during the meeting and to also accomplish other work. Since these interviewees considered their role in the meeting as non-essential, they were not concerned about missing any information being said in the meeting due to technology multitasking.

(3) Information Available on Laptops: The participants encountered times when they needed information during a meeting that was easily answered by looking up information on a web site. Additionally, laptops were often used to show supplemental pictures or prototypes during a meeting. However, the 8 participants who used technology in meetings changed their behavior when someone of higher status was in the meeting (e.g. a vice president) and there were explicit rules dictating how technology could be used. These mitigating factors are discussed further in the next section.

What other factors influence mixed reality behavior?

Power and Status

If a person in a higher status position was leading the meeting or even just merely present, this shifted how a participant technology multitasked. For the Mailroom Supervisor, any meetings with high level directors meant that all mobiles phones would be turned off. Power and status also changed the behavior of Software Engineer #1; he typically used a laptop during all meetings he attended. However, when an outside client was present, he would not use his laptop because he believed it rude to do so in this context. Lawyer #2 similarly changed his behavior depending on the status of his communication partner. If a senior ranked partner in the law firm was glancing at his Blackberry smartphone, the lawyer would not say anything. But, if he was talking with a lower ranked staff member who engaged in a similar behavior, he would use a phrase like “I’ll just come back later if you’re busy…” in a tone of voice to imply that the staff member should pay more attention to him. Participants recognized that they used technology differently depending on who else was present and that their reactions to technology multitasking changed based on status.

Rules for Specific Meetings

Three respondents described meetings where explicit guidelines about how technology could be used were announced by the meeting leaders. Software Engineer #2 set forth rules at the beginning of his meetings disallowing technology multitasking, and the Mailroom Supervisor and a Telephone Customer Service Agent mentioned how they were told at the beginning of particular meetings to turn off mobile phones. However, for the other five respondents where technology was used in meetings, rules were never made explicit. For the Retail Manager's work in the sale and maintenance of industrial air-conditioning units, mobiles phones continuously interrupted the work day and meetings. While the Retail Manager did not have explicit rules about mobile phone use, the implicit rule was that technology multitasking was acceptable for work related reasons. Similarly, the Electrical Engineer, Software Engineer #3 and Television Producer all used laptops to help provide supporting information throughout the meeting, but were never given explicit guidelines for how to technology multitask.

What are the positive impacts of technology multitasking?

Participants described the following positive impacts from technology multitasking: being able to show documents, images, and prototypes to other group members, access information on web sites, and the ability to communicate via instant messaging and e-mail. These benefits all relate to increased information availability that would not traditionally occur in the meeting without prior planning. Some of the participants also described the ability to multitask as an efficient use of time, especially when segments of the meeting were perceived as less relevant. Despite eliciting some positive benefits of technology multitasking, there were fewer experiences shared by participants compared to negative perceptions toward mixed reality. Essentially, participants were able to list reasons why technology could be positive in a meeting, yet were unable to share specific occurrences of these positive experiences. Benefits from technology multitasking may not resonate in participant's memories since negative emotions tend to be more influential in evaluations (Ito, Larsen, Smith, & Cacioppo, 1998).

What are the negative impacts of technology multitasking?

One of the negative impacts anticipated was information loss due to people's inability to focus on both the meeting conversation and the use of technology. However, none of the respondents expressed concern with retaining information or participating in meetings when technology multitasking. Software Engineer #1 described his ability to attend to his laptop and what was happening in a meeting as "bifocal attention" as the tasks he performed on the laptop were intentionally not complicated tasks (e.g. writing software code), but lightweight tasks such as checking e-mail. He felt confident that he could simultaneously listen to the meeting and technology multitask without detriment to either activity. The negative reactions participants described were based around perceptions of etiquette and normative multitasking behavior. Five of the respondents described situations where it was disrespectful when people used technology in meetings. For example, Lawyer #2 expressed his disappointment when trying to present information to a room of his peers.

> *I'll be giving a presentation, and I'll look out into the crowd and all the lawyers have their heads down looking at their Blackberry's. It's so rude. Why do they even bother coming [to the meeting]?*

The overall perception about negative outcomes from technology use in meetings was that it did not cause any informational loss but rather engendered negative emotions when it was deemed to be inappropriate. The fact that technology use was perceived as rude was not based on the fact that the team was not able to accomplish the meeting goals because some members multitasked. Instead, the negative perception was expressed by participants as an emotional reaction due to an implicit belief about how others should conduct themselves for a particular meeting.

Implications of Pilot Study on Research Methodology

Based on the results of the pilot study, mixed reality is a phenomenon that people understand conceptually and that some people have experienced in their work environment. Individual attitudes toward technology use shape how technology multitasking occurs in meetings, along with organizational factors and group norms. Organizations that emphasize continuous electronic availability (e.g. instant messaging and e-mail) and make accessible portable technologies were prone to mixed reality meetings. However, just because an interviewee worked at an organization with mixed reality did not mean his or her reactions to technology multitasking was similar to others. There were few explicit rules for how technology should be used in meetings, yet participants were able to articulate a set of standards for what they considered appropriate multitasking behavior. There was evidence that participants who used technology in meetings were conscientious about how others might judge this behavior, especially when outside clients or upper management were present in meetings. Overall, the pilot data conclusions support the research aims and conceptual model in the following ways.

Strong support:

- Mixed reality is a phenomenon that is experienced in real world settings.
- The types of organizations that have mixed reality are those where wireless networks and laptops/smartphones are easily accessible.
- Individuals whose job tasks primarily involve data processing tend not to experience mixed reality meetings.
- Individual attitudes and group norms determine if and how technology is used in meetings.

Some support:

- People who use technology are more satisfied in meetings.
- People change the way they use technology depending on who else is present in the room.

No clear support:

- Individuals who are strongly bonded with their team will multitask less.
- Individuals who have higher polychronicity will use technology more.
- Meetings are more productive due to technology multitasking.

Several methodological implications were drawn from the pilot study. The data collection should occur at companies where there is a high likelihood for mixed reality meetings based on technology availability and wireless network access. Furthermore, the population of interest should focus on information workers who utilize technology on a daily basis to complete most of their work tasks. Experiences must be collected from both people who choose to multitask in meetings and those who are merely present in these meetings (but do not multitask). An additional methodological implication from the pilot research is that it will be necessary to assess participant's own perceptions about technology use against actual observed behaviors. The pilot data found that participants were more likely to recall negative experiences with technology use in meetings and the data may be skewed if actual behaviors are not validated against individual perceptions. The following sections present the methodology used in Phase 1 (qualitative) and Phase 2 (quantitative) of this research.

RESEARCH DESIGN - PHASE 1: CASE STUDY & IN-DEPTH INTERVIEWS

In Phase 1 of this research, fieldwork was conducted on-site at a multi-national software corporation and in-depth interviews were completed with eight information workers from other software companies. The goal of this fieldwork was to create a narrative about mixed reality meetings that was based on data observed by the researcher and experienced by the participants. There exist few in-depth investigations of the phenomenon of mixed reality, therefore this research area is aided by a detailed exploration that describes when and where it occurs and identifies people's thoughts and explanations on the subject.

The case study and interviews focused on four themes that stem from the conceptual model previously proposed:

1) factors impacting the likelihood to multitask
2) people's behaviors in mixed reality meetings
3) people's attitudes toward mixed reality meetings
4) people's beliefs about how meeting outcomes are impacted by technology multitasking

From the data collected at the case site and interviews, the experiences of the participants were compared and contrasted and then analyzed in relation to the conceptual model themes. Based on this analysis, a narrative of mixed reality is presented in Chapter 4 that is grounded in real world experiences. The narrative and conceptual model were then analyzed against the survey data collected in Chapter 5. The survey data allowed for a comparison of the qualitative narratives against a larger population to improve the validity of the results.

Case Study Definitions

The case study method is the investigation of a phenomenon in its real-world context using multiple empirical methods (Yin, 2003). Case studies are highly contextual in that they cover a specific time period of the phenomenon and involve a small number of participants (VanWynsberghe & Khan, 2007). Researchers have typically used the case study method to analyze how and why particular events unfold or to compare how similar groups were impacted by a particular change. The rationale behind using the case study method is that it allows the researcher to delve into a real life context and produce a rich description from which to understand the situation—which then allows for the opportunity to build theory.

A case study can consist solely of one single case for analysis, or be made up of multiple cases which are then cross-compared. The methods used within the case study are typically analyses of physical artifacts, interviews with case participants, and observations made by the researcher. This flexibility in how the case study method can be used is also its critical weak point in terms of evaluating it as a methodology. Few case studies use the exact same set of methods, and even when similar methods are used for similar cases, there is no standard against which to compare the data collection procedures (there are no sets of controls in a case study like there are in an experiment). Beyond the fact that case studies are not easily compared across different researchers, the analysis and results also suffer from the same issues of validity. There is not a single standard from which to evaluate the analysis and results of a case study (like in an experiment where there are statistical regressions which can be used to demonstrate the power of the data.)

However, researchers have offered solutions for these limitations (see especially Eisenhardt, 1989). First, in regards to not being able to offer standards about the data collection procedures, Eisenhardt (1989) and Riege (2003) argue that using multiple observers and triangulating the data (by collecting the same data in multiple ways) can reduce researcher biases and offer diverging points of view which strengthen the analysis. When data is collected from additional sources its validity is improved by the fact that there are multiple lenses from which to demonstrate the legitimacy of the data.

Furthermore, it is recommended that follow-up studies using quantitative analyses can also augment the research as it helps gauge whether the patterns and relationships in the qualitative data exist with statistical significance. A model for this type of research is Cameron's (2007) dissertation that examined how office workers participate in multiple conversations using technology. Cameron began with a case study of five individuals engaging in these behaviors from which conceptual models about multi-communication were developed. These models were then tested using survey data to establish statistical significance for the relationships proposed in the conceptual model. Similarly, this research on mixed reality follows this same methodology of using multiple data sources for the qualitative phase and validating these results using hypotheses testing from survey results.

Theoretical Viewpoint of Case Study

The theoretical viewpoint that informs the data collection is adaptive structuration theory (AST) which posits that technology use in organizations is best understood as a dialectic between organizational norms, individual motivations, and the situated use of specific features of the technology (Orlikowski, 2000). This means that technology use cannot be understood as arising solely from one factor—each component (norms, motivations, technological features) has a role in shaping its use. For example, the original designer of a technology artifact had certain intentions and expectations for how the technology should be used (called embodied structures in AST). However, when that technology is used in real life, the user may utilize the technology in unexpected and novel ways, or bypass features because it suits her or his individual needs and the organizational context better (user appropriation). It is the interplay between the embodied structures and user appropriation that explain how technologies become used in context; this use is not static, it becomes re-contextualized as factors of the user's situation change too.

In line with the viewpoint of structuration, while the case study begins with a particular set of focus areas, the data collected will take an individualistic approach in understanding how the technology is used and why. For the portion of the case study involving in-depth field work, specific hypotheses will not be tested, instead the analysis will concentrate on comparing and contrasting individual behaviors in a way that represents and matches the participant's own experiences with mixed reality taking into account the organizational context and how technology is used. The data analysis will consist of coding the interview and observational data through grounded theory methods (similar to the pilot study described earlier in this chapter). This coding process will allow for a systematic analysis of the different participants experiences to find points of commonality and divergence.

The process to analyze qualitative data will follow Creswell (2003); it begins by the researcher reading through the field notes and interview data to get an overall impression of the data and then dividing the relevant pieces of text into segments. These segments are then coded into different themes or topics as they relate to the research questions. These themes are then written into narratives. A strong qualitative narrative uses multiple sources of data to examine the proposed themes (triangulation), have been reviewed by the participants for agreement (member checking), the researcher's personal biases have been disclosed, and a discussion of negative or discrepant information that runs counter to the proposed themes is examined and explained. From this analysis the narrative of mixed reality will be written which assesses the experiences against the conceptual model to improve our theoretical understanding of mixed reality. The next sections present further details about the methodological process for Phase 1.

Case Study Site: SoftwareCorp

Gaining Research Access

A multi-national software corporation was recruited by the researcher to participate in this project. To gain access, the researcher contacted SoftwareCorp's (pseudonym) Director of Corporate Communications via their e-mail address on SoftwareCorp's public web site. This director then forwarded the message to a liaison within the company whose responsibilities include fostering university internships and related projects. A one-page project pitch was submitted to the liaison who then obtained the necessary approvals for the research from a Vice President at SoftwareCorp.

Representativeness of SoftwareCorp

SoftwareCorp develops computer software products for individuals and businesses. The majority of product development and management happens within the United States, but SoftwareCorp also has business units located globally. SoftwareCorp is representative of many software corporations in the industry today who have cross-functional teams that work together from around the world.

SoftwareCorp was selected as an ideal case site because they were listed as a Fortune 500 company in 2008, its workers rely on information technologies to produce and manage their work, and their offices were wirelessly networked and physically accessible to the researcher. A Fortune 500 company is determined by an annual ranking based on gross revenue of publicly traded organizations calculated by Fortune magazine. The rationale behind selecting Fortune 500 ranking as a criterion is because these organizations, by nature of their revenue, might be considered industry leaders. An organization in this position is likely to rely on information technologies to operate on a global level and help set standards for technology use in its daily operations.

Solicitation e-mails (to be a case site participant) were sent to 100 other companies with whom the researcher was able to elicit contact information for; and out of these 100 solicitations three other corporations expressed interest in being a part of the project. However, the researcher was never able to successfully negotiate final permissions or identify an appropriate liaison within these companies, so access to these other sites was never granted. While ideally there would have been more than one case site used in this research, this limitation was addressed by incorporating in-depth interview data from individuals following the fieldwork at SoftwareCorp.

Individual Participants from SoftwareCorp

The case study at SoftwareCorp was based on data from two participants whose daily activities involve information work and who take part in mixed reality meetings. Information work is operationalized as a reliance on the use of information technologies to produce, manage and capture information in performing daily work tasks. Examples of information workers include computer programmers, business consultants, middle and upper level management, and financial advisers. Job roles that deal with information work but at the level of customer service representatives, data entry clerks and administrative support staff are considered "data handlers" and are excluded from this operationalization of information work. Findings from the pilot study demonstrated that data handlers did not typically experience technology multitasking in meetings.

The participants recruited at SoftwareCorp met the following criteria:

- Employed full-time
- Performs "information work" as a common activity for their job
- Age 18 or more
- Attends at least 1 meeting per week

- Regularly uses a laptop computer in meetings
- Has worked with their current team for at least 1 year
- Is not a telecommuter or virtually located employee

Additional details about the two participants from SoftwareCorp are described in Chapter 4.

Instruments Used at SoftwareCorp Case Site

For the case study, a mix of semi-structured interviews and field observations were used to understand how participants experience mixed reality in terms of meeting type, polychronicity, cohesion beliefs, technology multitasking, copresence management, perceived productivity, and meeting satisfaction. The data collection procedures are outlined below:

1. *In-depth introductory interview*. A one-on-one interview was conducted in a semi-structured format. The interview accomplished the following:
   a. Introduced the participant to the research topic and obtained informed consent.
   b. Completed questionnaire to verify polychronicity level.
   c. Obtained the participant's initial opinions about mixed reality meetings.
   d. Prepared the participant for upcoming observation days.

2. *Job shadowing.* Shadowed the participant on two separate work days when meetings were held. The researcher followed the participant throughout their entire work day and assessed:
   a. General organizational environment in regards to technology use.
   b. Technologies used throughout the work day.
   c. Tasks completed simultaneously, tasks completed singularly.
   d. General style and purpose of meetings.
   e. Technology use by participants and by others in the room.

3. *Wrap-up interview.* Closing interview via telephone for 20-30 minutes. A debriefing interview where participants asked questions and the researcher had an opportunity to follow-up about any points of clarification needed.

Data Analysis for Case Study

Data analysis followed the methods recommended by Eisenhardt (1989) and Yin (2003) who propose concurrent coding and analysis. To analyze the data while collecting means reflecting upon each day of observation/interviews by both coding the data and writing a reflexive diary about the day. The purpose of writing and analyzing the data immediately after collection is to take advantage of the fact that impressions and observations are still fresh in memory. Additionally, performing clerical work on the data during the process of data collection offsets the need to complete this time-consuming task later. The software tools used to transform and code the data were Microsoft Word and Excel.

The analysis process adopted Miles & Huberman's (1994) three-step approach: data reduction, data display, and conclusion drawing and verification. With data reduction, the purpose is to transform the data into meaningful units—from the initial field notes, to the coding of relevant text statements, and then to the final narrative; the process of data reduction is constantly occurring as the researcher analyzes the data. For data display, Miles & Huberman emphasize the importance of representing the data in charts, graphs, tables, and any other visual representations that enlighten the analysis. From the data reduction and displays, conclusions can be written which must then be verified.

Ensuring Data Quality

To ensure the reliability of the data, the case study used multiple sources of data. Each of the main research themes has two sources of data: the participant's out of context perspective (face-to-face interview) and the researcher's observations (field observations). Since the research constructs are examined using both the participant's and researcher's perspectives, this helps ensure that the patterns of behavior believed to be occurring are upheld over time (reliability) and that the researcher's viewpoint is in line with the participant's own beliefs about mixed reality (validity).

One concern with participant observation methods is reactivity, which occurs when participants act differently due to the researcher's presence. To mitigate reactivity during the field observations, the researcher met with the participant for a face-to-face interview prior to job shadowing which helped build rapport and familiarity. In order to frame the field research in a metaphor that the participant could relate to, the investigator described the observational days as "job shadowing" which is an understood concept for job training. Furthermore, emphasis was placed in explaining the observations as a learning experience for the researcher and not a critique of how the participant conducted his daily work activities. To help further eliminate or address bias in the data due to reactivity, in the follow-up interview over the phone, the researcher asked the participant about his comfort level during the field observation days and what behaviors, if any, were different than usual due to the presence of the researcher.

In summary, the case study was a study of two information workers who experience mixed reality meetings at a software corporation. A combination of researcher interviews and direct observations, in addition to participant self-reports, were used as the primary sources of data. The data collection focused on the research themes proposed in the conceptual model in order to assess the utility of the model. Following the case study, interview data with eight other information workers was collected.

In-Depth Interviews

Eight (8) information workers, in particular people who design software and web site products, were recruited for one-on-one interviews with the researcher. The participants were obtained from a San Francisco Bay Area e-mail list targeted at web site professionals. This list regularly sends out messages about new jobs in the area and upcoming presentations given by the group. The researcher sent a message to this e-mail list requesting volunteers to participate in a project about technology use in the workplace. A description of the participants is presented in Table 9.

The polychronicity column in the table was calculated using the Polychronic-Monochronic Tendency Scale from Lindquist & Kaufman-Scarborough (2007) which has a theoretical range from 5 to 35. A higher score on the PMTS scale indicates a greater preference for multitasking in life. All participants shared a common work style of relying on information technologies to complete their work tasks and met the same screener criteria used with the SoftwareCorp participants.

Participant	Age / Gender	Polychronicity	Job Title	Company Size (Employees)	Years with Company
P1	28 / F	16	Product Manager	50	2
P2	39 / M	21	Chief Architect	150	9
P3	55 / F	19	Usability Manager	4900	1
P4	49 / M	11	Technical Writer	300,000	25
P5	57 / M	16	Software Engineer	66,000	12
P6	35 / F	14	Knowledge Management Developer	15	6
P7	45 / M	17	Industrial Designer	14,000	2
P8	39 / F	17	Customer Insights Manager	160,000	5

Table 9: Summary of Interview Participants.

As with the case study data, the interview data was written into a series of field notes which were then analyzed using grounded theory techniques. In the next chapter, additional details are presented about the questions used during the interviews. The goal of Phase 1 was to create a narrative of mixed reality based on fieldwork and interview data. Additional details on this process and the narrative are presented in Chapter 4. To strengthen the findings from this qualitative phase, survey data was used to compare the narrative results against testable hypotheses. The survey methodology is presented in the next section.

RESEARCH DESIGN - PHASE 2: SURVEY AT SOFTWARECORP & ONLINE PANEL

To determine how the seven constructs of meeting type, polychronicity, cohesion beliefs, technology multitasking, copresence management, perceived productivity, and meeting satisfaction are related, the survey method was used to test the relationships. In general, survey methods are used to generate data about characteristics, attitudes, and behaviors on a wide range of topics. Some examples of common survey topics include assessing people's opinions about politics, asking people to rate the performance of others, and finding out how often and why people use different technologies. Survey data is collected through a systematic series of questions which can be gathered in-person, over a telephone, via e-mail/web site, or postal mail. The data for a survey are collected from a sample of people from which the results are used to generalize to the larger population (Babbie, 1995).

Participants in this survey were asked to respond to a questionnaire of approximately 30 items on the topic of mixed reality using a web-based survey tool offered by Zoomerang (http://www.zoomerang.com). Two populations were used for the survey: information workers at SoftwareCorp (n=156) and an online panel of information workers (n=110). The purpose of using these two samples was to validate the qualitative experiences against larger sample sizes to assess the generalizability and validity of the findings. Details about the hypotheses and questionnaire development are explained further in Chapter 5. This chapter concentrates on a presentation of the methodological issues with using web-based surveys and online panels. Aspects of the survey implementation are discussed briefly, but the main purpose of this section is to identify and address validity about the survey process in general.

Advantages of Web-Based Surveys

One of the main benefits of conducting web-based survey research is that it is less expensive than paper-based and telephone surveys (Gunn, 2002). Cost estimates for telephone surveys can range from \$40 to \$100 per completed response (Kraut et al., 2004); while the approximate cost per response using an online panel can be about half that. Additionally, online questionnaire data can be collected faster since the responses are recorded immediately onto a web server and the researcher does not have to wait to receive back a paper survey or wait for the telephone interviewers to individually reach each participant at the right time. Other benefits include the fact that participants can complete the questionnaire at their own pace and if the questions are written clearly, there are no issues with miscomprehension or memory overload as participants do not have to remember the question they are hearing out loud during a telephone survey. The elimination of a compliance effect is another benefit of online surveys since respondents have no pressure to be agreeable or respond in a way that they think the interviewer would like best.

External Validity of Web Surveys

In web-based surveys, the validity of the responses is uncertain when the research is focused on topics that are intended to generalize to everyone regardless of Internet access. For example, web-based surveys on topics such as presidential elections or health care exclude the responses of people who do not regularly use computers or have Internet access. In this research on mixed reality, the population under investigation is specifically people who work in offices where computing resources are available; therefore using a web-based survey is likely to be advantageous since the population only includes individuals who have access to computers. In the next section, the methodological issues with using an online panel are examined further.

Online Panels

In brief, online panels are created from databases of individuals who have agreed to participate in surveys (typically in exchange for gift cards or other rewards). Panelists are profiled on demographic characteristics about themselves, their household, work, or any other factor that would be of interest to researchers (such as political orientation). These online panel databases are maintained by marketing companies who work with researchers to select the appropriate sample based on the criteria desired for the project.

Zoomerang was selected as the best marketing company to partner with after polling other academic researchers on the Information Systems World (ISWorld.org) mailing list about the services they had used to obtain an online panel. After comparing the service costs and database samples referred, and evaluating that against additional research about marketing firms and survey tools, Zoomerang had the most appropriate sample. Specifically, Zoomerang offered an online panel consisting only of technology workers which matched the desired sample of information workers. Participants in Zoomerang's database earn points when they complete surveys and these points can then be redeemed for gift certificates.

Survey Implementation

To conduct the survey, Zoomerang's web-based interface was used to load the survey questions into a series of clickable web pages. Zoomerang then sent a message to participants in the sample requesting their participation in the study. Based on the research budget, once the desired number of participants completed the questionnaire, the researcher was given access to the raw data from which to conduct the analysis. Precedence for the legitimacy of using online panels for academic research has been set by Baltes & Heydens-Gahir (2003) who conducted a survey of the behaviors that impact work-family balance, Piccolo & Colquitt (2006) who examined a model for the relationship between job characteristics and transformational leadership, and Wallace (2005) who developed and validated a model for cognitive failures in the workplace using data from an online panel.

Validity of Online Panels

One major issue with the validity of online panels is the sampling techniques used to find participants. Online panels are typically developed by for-profit companies though some universities also maintain similar online panel databases (Syracuse, Michigan, and Vanderbilt for example). These individuals are primarily recruited into the panel through direct mail and online advertisements. Every individual in the panel is profiled so that demographic information such as age and location, the type of work they do, in addition to his or her lifestyle habits is recorded. When a researcher recruits from an online panel, they select the demographic segments of interest in order to target the questionnaire to the ideal sample.

Two major issues with recruiting from an online panel are the legitimacy of the panelist's identity and the representativeness of the panel database overall. For the first issue, it is conceivable that individuals not only misrepresent information in their demographic profile, but also hold multiple accounts in an effort to earn more rewards for taking more surveys. The companies that maintain online panels address the issue of panelist legitimacy by correlating e-mail addresses to physical mailing addresses to try and ensure that people do not register into the panel under multiple e-mail accounts. In regards to panelists misrepresenting their demographic information, there is little basis to suggest that participants in online panels are any more likely to lie when creating their demographic profiles compared to panelists in other avenues of research. For the second issue on representativeness, a selection bias occurs with the online panel since participants who agree to sign up for online panels have chosen to take the time to complete profiles and earn rewards. These individuals may differ from others who do not want to participant in an online panel and therefore may lead to survey results which do not truly reflect the attitudes and behaviors of the intended population.

Daugherty, Lee, Gangadharbatla, Kim, & Outhavong (2005) conducted a survey with 1,822 online panelists to elicit the reasons these individuals participate in web-based research. Four sources of motivation to be an online panelist were tested: utilitarian (e.g. financial incentives), knowledge (e.g. need to understand/learn), value-expressive (e.g. individuals feel they are allowed to express their self-concepts/values) and ego-defensive (e.g. to feel a sense of belonging or reduce feelings of guilt for not participating). The results of their survey indicate that individuals with the most favorable attitude toward being in an online panel were those who rated the knowledge and value-expressive motivations as their greatest incentive to being in the panel. The fact that monetary or material incentives have little impact on people's motivation to participate is further backed by Göritz (2006).

In an experiment using online panelists that measured their response rate and retention, Göritz found that offering a cash lottery incentive did not significantly change the response rate or retention of online panelists. The implication of this finding may be that within the population of online panelists, respondents will be biased toward only responding to surveys that match their own personal interests. However, it is important to note that both the Daugherty et al. and Göritz studies were based on university-sponsored online panels, and therefore the potential for emphasis to be on knowledge and information sharing may be underscored more compared to a commercial market research enterprise with an online panel.

While the issues of external validity and selection bias are two major drawbacks with web-based surveys and online panels, it remains the case that the population under investigation for mixed reality is not meant to generalize to everyone who works full-time. And, since the ideal population will be difficult to reach otherwise, the use of an online panel and web-based questionnaire is the best avenue for this survey. The legitimacy of using online panels and web-based data collection has been spurred by the growth in the creation and maintenance of online panels and a general trend toward increased usage of online research as compared to traditional avenues such as direct mail, polling at public places such as malls, and telephone surveys (James, 2000). Additionally, academic researchers are turning to free online research services such as Online Social Psychology Studies (http://www.socialpsychology.org/expts.htm) which allows any academic researcher with institutionally approved research to post a survey on their web site that fits into the genre of social psychology studies.

In terms of the validity of Zoomerang's online panel, Zoomerang reports the following maintenance techniques they utilize to improve their validity:

• Metrics are kept on each respondent's responsiveness, tenure in the panel, frequency of participation (so that the researcher's study is balanced in terms of the types of online panelists being sampled)

• Panelists are recruited from the widest range of sources possible (both online and offline)

• Samples are balanced against US census data to reflect similar populations on attributes such as gender, annual household income, and age

While consideration was given to creating an online panel using recruitment methods such as e-mailing people at various organizations based on information available from web sites, purchasing e-mail lists from marketing firms, posting online advertisements, and newspaper/flyer advertisements, these procedures would likely be invasive, difficult, time-consuming and cost-prohibitive along with the fact that the respondent set would likely not differ significantly enough from the Zoomerang panel.

ALTERNATIVE METHODS CONSIDERED

Are the case study, interview, and survey methods proposed here the best way to understand the phenomenon of mixed reality? Two alternate methods for data collection are briefly proposed and then a rationale for the current methodological design is given.

Alternate Method #1: Videotape Analysis of Group Meetings

In this first alternate method, the investigator would videotape group meetings where individuals use technology. Ten (10) meetings at different organizations would be filmed. For each meeting, there would be one camera focused on all the participants in the meeting, and a second camera capturing an up-close examination of one of the member's technology use. With these two views of the meeting the researcher would have a visual record of all the verbal communication and behaviors of group members along with a detailed view of how one individual member used technology.

The strengths of this method are that the researcher would have an unbiased record that relates technology use to the events of the meeting; for example, if the user decides to look up a definition for a word on her or his laptop based on what was just spoken out loud, there is a clear record linking the meeting event and the technology use. One of the drawbacks of this method is that most organizations would be uncomfortable with giving permission to film a private company meeting. Even if an organization is amenable to the filming, the presence of the camera, especially one focused on the individual technology user would likely change the behavior of the group member so that the meeting is unnatural and not reflective of normal practice.

Alternate Method #2: Experimental Groups

In the second alternate method, an experiment would be conducted with small groups. Random subjects would be recruited to participate in an experiment about group work and be placed in one of four experimental conditions:

- no technology use
- confederate user – uses technology for group task only
- confederate user – uses technology for private work and group task
- confederate user – uses technology for private work only

Each group would consist of 6 participants and they would be asked to complete a collaborative task requiring the effort of all participants. The type of technology multitasking would differ across conditions, which would be manipulated through the provision of a networked laptop computer to a confederate. The investigator would tell the participants that in order to complete the collaborative task that they could use any resources available in the room, even their own personal belongings.

Deception would occur in the three conditions where a laptop was present: a confederate of the researcher who would be viewed as a peer to the other participants would announce that she happened to have her laptop computer available. Depending on the condition, the confederate would use the laptop in ways that help with the group task or utilize it for private work (e.g. checking e-mail, playing a game). The groups would then be scored on their performance on the collaborative task and a post-task survey would ask participants to express their attitudes and opinions about the confederate's use of technology in the meeting.

While the experimental method allows for a highly controlled environment that could capture the percentage and type of technology use by the confederate, this artificiality is its greatest weakness for understanding mixed reality. Organizational norms for technology use cannot be assessed in the experiment, and since the participants have little incentive to build rapport or care about other people's behaviors (since everyone is a stranger), cohesion beliefs cannot be accurately gauged. Furthermore, an experimental collaborative task does not have the same characteristics of a large scale organizational work project.

The strengths of the proposed case study, interview, and survey methods outlined previously are as follows: the case study and interviews provide a grounded real-world description of the phenomenon from which the findings are then validated quantitatively through the survey. This triangulation of the data provides multiple sources of evidence that the behaviors exhibited by the small sample of case and interview participants can be extrapolated to the larger population of information workers.

LIMITATIONS OF THE RESEARCH

While the strengths of the research have been described above, there are limitations on the validity of the findings in the following areas.

Role of Time and Behavior Change

The behaviors of group members who have been together longer are different than those of younger groups. As time spent together increases in a group, the level of social cohesion increases (Manning & Fullerton, 1988) due to shared experiences and increased comfort in the relationships. One of the limitations of this research is that changes in mixed reality in a single group or individuals are not measured over a significant length of time. In the case study, the participant data collection will occur over a 3-month period (approximately), and with the survey data it will not be known if the respondents are thinking about a team that they know well or not. It is certainly possible that in a group's history that the norms for technology use will change over time and this research does not assess the mechanisms for changes over time and how this impacts technology multitasking.

Differences in Technology Types

Another limitation of this research is that little emphasis is given to the different affordances and uses that various portable technologies have. For example, does the use of a mobile phone in a meeting have the same impacts as the use of a laptop computer on perceived productivity and meeting satisfaction? This research approaches technology only generally and does not capture if and how various media result in different experiences for mixed reality settings. Specifically, the laptop computer is the technology assessed as the main artifact in mixed reality meetings.

Furthermore, in regards to the different features of technology as it impacts mixed reality, no distinction is made between the multiple types of tasks technology is used for beyond "used for group work" or "used for private work." The implication of this broad categorization is that the task type differences are lost in the analysis. For example, a laptop used in the meeting for checking private e-mails, drafting a document on a separate work project, and exchanging instant messages with a coworker would all be labeled as "used for private work." However, if these specific tasks are not analyzed separately it is unclear whether these distinct tasks have varying levels of impact. While the qualitative fieldwork will capture some of these task distinctions, the interview and survey data will not be able to address this issue adequately since people will be responding out of context.

CONCLUSION

In the first three chapters, mixed reality has been presented as a context where some individuals participate simultaneously in group meetings while using technology. In mixed reality meetings, collaborative group work can be enhanced by the technology through increased access to information, but individuals using technology may also be a distraction to the group task. In most traditional research on group meetings, the general findings about group work have purported that face-to-face meetings are the most communication rich and ideal context for accomplishing complex tasks (Daft & Lengel, 1986). This research attempts to extend our knowledge on group meetings to identify and understand how today's collocated groups may be impacted by technology multitasking.

A conceptual model was developed that proposed mixed reality occurs based on a combination of meeting type, polychronicity, and cohesion beliefs. This combination of factors determines the type of technology multitasking that occurs and whether individuals try and manage their level of copresence. The evaluation criteria to assess the impact of mixed reality was described as perceived productivity and meeting satisfaction. The conceptual model was developed from a review of the literature and based on the results from a pilot study with 15 office workers.

From this model, a two-phase methodology for investigating mixed reality was proposed. In the first phase a case study of two individuals who use technology in meetings and in-depth interviews with eight information workers is used to create a narrative about mixed reality. In the second phase, the themes and findings developed from the first phase are then statistically validated using a survey. This methodology balances the need for detailed descriptions of mixed reality behavior against quantitative data to assess the generalizability of the results.

In the next two chapters, Chapters 4 and 5, each research phase is presented in greater methodological detail and the results are analyzed. In the final chapter, Chapter 6, conclusions are drawn about our theoretical understanding of group work and the impacts of technology multitasking on group meetings.

CHAPTER 4: *QUALITATIVE RESULTS (PHASE 1)*

Chapter 4 presents the qualitative phase research results from fieldwork data collected at SoftwareCorp (a pseudonym for the organizational case site) and in-depth interviews. Two senior managers from SoftwareCorp were interviewed and observed at their jobs and eight information workers from eight different corporations participated in 1-hour one-on-one interviews.

Mixed reality is an emerging area of research and to date there exist few systematic studies of this phenomenon in organizational contexts. The purpose and contribution of this qualitative work is to describe and analyze mixed reality behaviors and attitudes drawn from real world organizational experiences. These experiences are systematically interpreted using a grounded theory approach. A framework for addressing when and why mixed reality occurs and how people perceive its impacts is presented. This outcome contributes to the nascent literature and also tests the soundness of the conceptual model used in this research.

This chapter is organized by two main sections: the first describes the case study at SoftwareCorp and associated results, and immediately following is the second section which reports the interview data and findings. The chapter concludes with a summary analysis and its implications for the conceptual model and quantitative phase.

THEORETICAL BACKGROUND & CONCEPTUAL MODEL

This qualitative research is based on the theoretical foundation that organizational meetings are socially constructed contexts in which group interactions can be analyzed as they represent larger organizational themes (Schwartzman, 1993). It is from these detailed observations and analyses of routine behavior in meetings from which patterns emerge that represent what is considered acceptable behavior, how information is communicated, how people view themselves within the organizational hierarchy, and how people work together.

Three themes are used to analyze the qualitative data on mixed reality meetings. The conceptual model, shown in Figure 4 below, represents the relationship of the research constructs. In the first theme, factors contributing to the likelihood to multitask in meetings are reviewed (*meeting type*, *polychronicity,* and *cohesion beliefs*). Following this, the second theme examines how individuals behave during mixed reality meetings (*technology multitasking* and *copresence management*). And, the third theme looks at individual outcomes from multitasking in meetings (*meeting satisfaction* and *perceived productivity*).

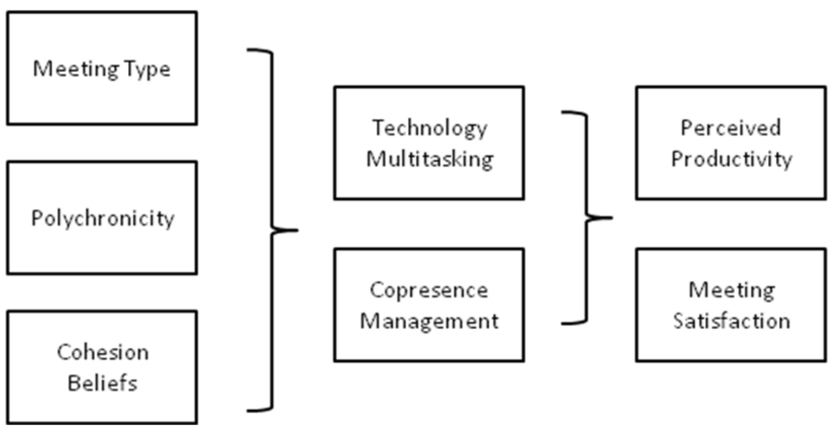

Figure 4: Conceptual Model for Mixed Reality.

These themes are used as an organizing framework for discussing the results presented in both sections of the qualitative research and are used in the following sections for presentation of the survey results.

CASE SITE OVERVIEW

The case site overview is a detailed account of the researcher's methodology and description of the SoftwareCorp site. A description of SoftwareCorp and the two participants is presented to give contextual background to the evidence in the case study results section. In this overview, the context of this study is characterized by three main factors: the physical layout of SoftwareCorp in general, the technological infrastructure used by the participants, and the physical setup of the participant's work cubicle.

The case site methodology is described and shortfalls with data collection are examined, too. In brief, the methodology consisted of hand-written notes captured on-site across six separate days in a time period spanning October 2008 to January 2009. These data consisted of notes from 1) an in-depth interview with each of the two participants, 2) observing each participant working at his desk, and 3) observations of face-to-face meetings (with the participant and other meeting attendees) in conference rooms. The following sub-sections describe this research process with greater detail along with the contextual factors of SoftwareCorp that shape mixed reality behavior and attitudes.

Obtaining Research Access to SoftwareCorp

SoftwareCorp is a Fortune 500 software development company with headquarters in California. It operates globally with approximately 15,000 employees around the world. Its software products are used both by individuals on personal home computers and they offer an enterprise-level product designed for businesses. To protect organizational privacy, details of the company's products and lines of business have been omitted or are intentionally vague.

The researcher obtained access to interview and job shadow two employees at SoftwareCorp's California headquarters (this process was described previously in

Chapter 3). To solicit two employees for job shadowing, the SoftwareCorp liaison sent an e-mail message to employees categorized as "developers" or "project managers" asking for volunteers. These job categories were selected by the researcher as representative of this study's definition of information workers. Within minutes of sending out this message there were 6 candidates who replied; the first development manager and the first project manager to reply were selected as the participants. While the characteristics of the non-selected candidates are unknown, if the two selected had not been able to meet the criteria for participation they would have been replaced by another from the pool of candidates.

Physical Description of SoftwareCorp

Fieldwork at SoftwareCorp took place in a 4-story office building in a major city in California. Along with providing work cubicles for employees, the building includes a corporate cafeteria, fitness facility, game/break rooms, and coffee/kitchen areas on each floor. When visitors enter through the main entrance they are greeted by an attendant at a central information desk. The main lobby has two separate waiting areas, both decorated with product awards, plaques, and company signage/slogans. The inside of the building is spacious with high ceilings and the interior design exudes a contemporary feel with silver-toned fixtures, clean lines, and modern style furniture.

The building accommodates approximately 1,000 workers. The majority of employees work on floors 2, 3, and 4 with each floor assigned by product functionality (e.g. everyone who works on the home consumer product is on floor 3). Each floor consists of sets of cubicles, though there are three cubicle sizes based on seniority. There are also meeting rooms on each floor of various sizes and wireless Internet access is available everywhere in the building. Access to work areas and meeting rooms are locked and require electronic badges in order to pass through different parts of the building.

Based on the researcher's experiences with 20 other office visits throughout this dissertation work, the physical context of SoftwareCorp appeared typical for the industry. The layout of work cubicles, amenities, security features, and modern interiors are standard for software technology companies and SoftwareCorp's physical premises are a representative environment for this study. Representativeness is important because people's behavior and attitudes with technology are informed by the environmental setting in which they work. For example, physical proximity to coworkers can influence the use of communication technologies (e.g. Kraut, Fussell, Brennan, & Siegel, 2002).

Technological Description of SoftwareCorp

As with the physical layout, the technological environment is relevant for understanding the work context of participants. Some corporations place restrictions on an employee's ability to personalize work computers; for example, not allowing employees to install non-sanctioned software. In addition to controlling computing applications, some corporations disallow how the installed software can be used by placing filters that limit or block access to content deemed disruptive or inappropriate (e.g. personal e-mail and job search web sites).

The technological infrastructure contributes to employee attitudes toward technology use and can inhibit or promote work processes (Kanter, 2000). According to the two participants, SoftwareCorp was not restrictive in how work computers and web sites could be used. The participants were able to install any new software or web site applications as they desired, and using the computers for personal matters was considered acceptable. While the researcher did not review the SoftwareCorp official employee handbook, both participants did not hesitate to complete personal tasks on their work computers while being observed for this project.

Desktop computers, laptop computers, large flat screen monitors, and smartphones were accessible to all product managers and developers at SoftwareCorp. Both participants had three computers in their cubicle and they also had smartphones that were issued by SoftwareCorp (a smartphone being a mobile phone that can also be used to check e-mail and browse the Internet). Both participants also had personal mobile phones. Pictures of the cubicle work areas are shown in Figure 5, Figure 6, and Figure 7 on pp. 98-99. All employees had a 2-monitor setup at their desks, meaning that multiple windows could be opened and moved across both monitors. This type of dual monitor setup provides additional screen space so that it is easier to see many computing applications simultaneously.

SoftwareCorp's technological access was perceived by the participants as being encouraging of using new or different technologies as long as it supported or enhanced their work. For example, on the first day the researcher arrived for observations, the participant was excited to show a new computer that he had requested which would be used as a testing environment for the software product. He further explained that he never had difficulty obtaining approvals for technology purchase order requests.

The significance of SoftwareCorp's allowance and promotion of technology use is that work is not limited to physical location, time of day, or even a particular technological object. The same e-mails and work documents can be accessed on a smartphone, laptop, or desktop computer. The lines between work and personal time are blurred as both are intertwined throughout the day. Mixed reality meetings are a natural outgrowth of this technology-infused environment as people are expected to be available to respond to e-mails and instant messages continuously throughout the day.

SoftwareCorp Participant Overview

This section presents the characteristics of the two participants from SoftwareCorp. Both participants are similar in seniority, tenure, and cubicle layout but differ in polychronicity level, the number of people they manage, and job responsibilities. The analysis is serendipitously strengthened by the fact that the two participants are similar on important surface characteristics, but diverge on work communication partners and multitasking preferences.

Charles and Sam (pseudonyms) are both senior managers at SoftwareCorp with each having been at the company just over ten years. Both Charles and Sam are leads for their respective products and supervise the work of other employees. While their immediate teams are all collocated together in the same building, due to the size of the projects, both Charles and Sam work extensively with other teams who are distributed across the US and internationally (primarily with India). Table 10 provides an overview of each participant. Polychronicity score was captured via a paper-based questionnaire collected during the introductory interview (using the Polychronic-Monochronic Tendency Scale described in Chapter 2).

	Charles	Sam
Age	38	31
Years at SoftwareCorp	11	12
Polychronicity Level (Range = 5 – 35)	15	26
Business Unit	Enterprise Level Product	Home Consumer Product
Job Title	Senior Product Manager	Senior Manager of Development
# of People Managed	4	8
High Level Job Tasks	Presents product demos and features to business clients in formal presentations Creates documents that explain the benefits and features of the software product Helps define scope and features of the product Builds and maintains SoftwareCorp's business relationships	Manages the development of the home consumer product at the software code level Works with Quality Assurance team to fix software bugs Helps define scope of product and its technical specifications Works with product managers to ensure timeline for development is feasible

Table 10: SoftwareCorp Participant Summary.

The researcher met Charles and Sam for introductory one-on-one interviews in October 2008. These 45-minute interviews took place in the participant's cubicles. At these initial meetings, the researcher introduced herself, obtained informed consent, received responses to the polychronicity questionnaire, and explained the research process in detail. Charles and Sam explained their motivation to participate based on being personally interested in the issue of workplace multitasking. Charles had not even noticed in the initial e-mail solicitation that there was a $200 honorarium for participation. While Charles and Sam likely know each other because they have both been with the company for a long time, they do not work with the same teams or on the same projects, and they are physically located on different floors at SoftwareCorp.

Following this introductory interview, two observational days of job shadowing were scheduled with each participant.

Table 11 shows a summary of how each job shadowing day was spent across major activities (working from cubicle, conference calls, and face-to-face meetings). At the end of each day the researcher asked how typical the day had been for the participant; the samples are further balanced since each was observed on one day deemed typical, and one perceived as less busy. The next section describes the observational process in greater detail.

	Sam		**Charles**	
Activity Summary	**Day 1 (10/29/08)**	**Day 2 (01/05/09)**	**Day 1 (10/30/08)**	**Day 2 (12/11/08)**
Minutes Job Shadowed	501	516	408	467
Hours Job Shadowed	8.35	8.60	6.80	7.78
# of Conference Calls	2	0	2	5
# of Minutes in Conference Calls	96	0	59	123
# of Face-to-Face Meetings	2	2	1	2
# of Minutes in Face-to-Face Meetings	119	78	233	192
Typical Day?	Yes	No (Less Busy)	No (Less Busy)	Yes

Table 11: Summary of Observational Days at SoftwareCorp.

Observations of Participant in Cubicle

The physical set up for the observations was managed by having the researcher sit behind and to the side of each participant. Figure 5, Figure 6, and Figure 7, on the following pages, depict the cubicle set up and where the researcher sat in relation to the participants. Both participants had the same size cubicles and same general configuration for where their computers, telephone, and filing cabinet space were located. Both had a desk phone to their left, and one additional computer behind them which was used as needed to test the SoftwareCorp product.

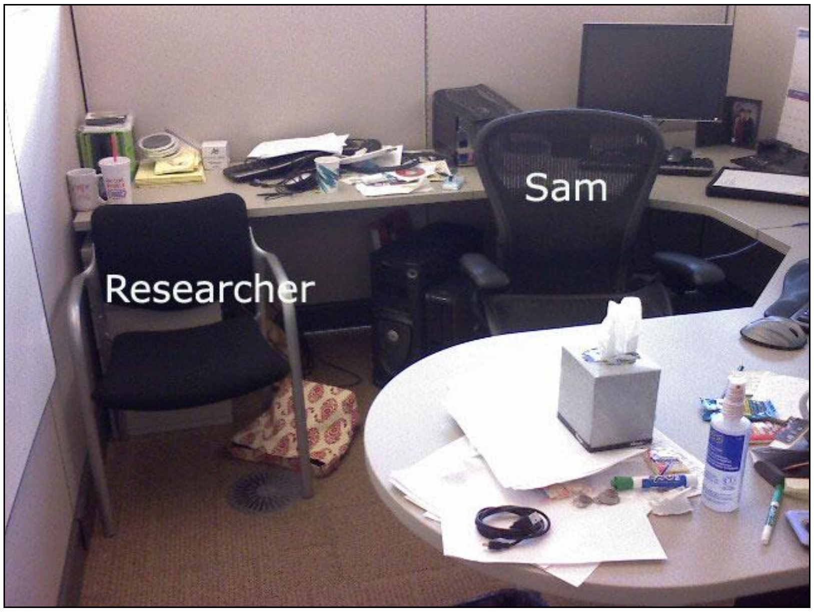

Figure 5: Researcher Position for Observations of Sam.

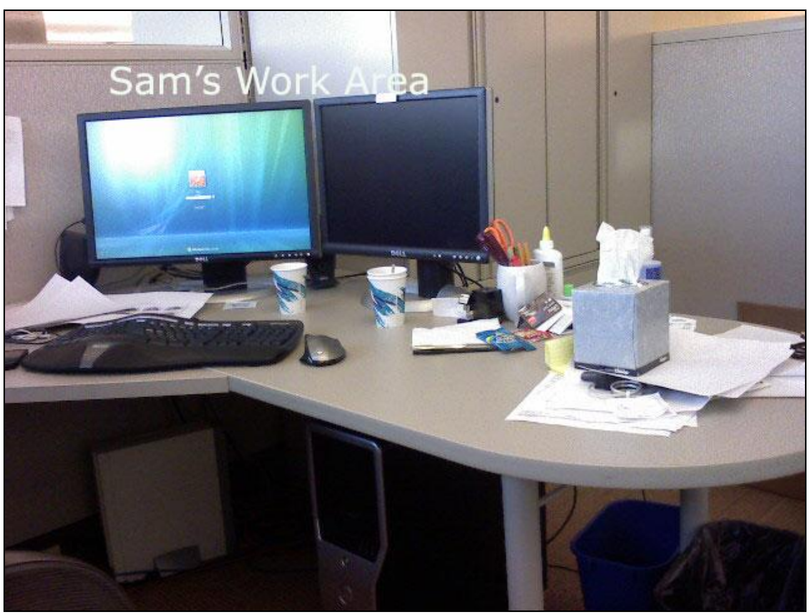

Figure 6: Sam's Dual-Monitor Work Area.

Figure 7: Researcher Position for Observations of Charles.

The benefit of the researcher's position for observations was that participants did not feel stifled by the researcher's presence and were able to move about normally within their work space (as compared to if the researcher had sat within inches next to the participant). Once the researcher was situated, she never had to move or re-locate herself within the cubicle, indicating that the participant was able to access all of his work artifacts without disruption. The researcher further verified that the participants were comfortable by asking if her placement within the cubicle was acceptable—both participants verbalized that they approved of the positioning.

The downside to this set up from the researcher's perspective, however, was that it was not possible to read everything that was being typed on the computer screen. The researcher was always able to identify the given computing applications being used, but text that was typed was sometimes illegible from the observational position. While the on-screen text could not always be observed, this did not spoil the intended purpose of the job shadowing; which was to notate how the participant completed his work tasks. It was still possible for the researcher to capture the start and end times of the different computing applications being used, when interruptions occurred to those tasks, and the different forms of multitasking (e.g. talking on phone while browsing e-mail). The researcher purposefully did not interrupt the participant to ask any questions during the observational period since it would interfere with the natural work pattern. However, the researcher did use breaks within the day such as lunch, time spent walking to meetings, and the last minutes of the day to ask follow-up and clarification questions.

The hand-written notes from the interviews and fieldwork days were transcribed into electronic notes in Microsoft Word and a time log of events in Microsoft Excel. The electronic notes consisted of background information about the participant and other general impressions and observations about being on site at SoftwareCorp. These notes followed the ethnographic field note model (Emerson, Fretz, & Shaw, 1995). As prescribed by Emerson et al., the researcher's field notes should be a coherent telling of the observed events with special care given to notating whose perspective is being recounted and which details have been selected to be included. The field notes can also be distinguished from the time log of events in that the former includes the researcher's subjective interpretation of the observations whereas the time log is an objective record of every observable activity that occurred.

The time log data consisted of a list of the events that occurred in the participant's day and during meetings using time stamps (see Table 12 as an example segment of the time log). This log captured to-the-minute activities of the participant at his desk and during meetings. The only time segments that were not captured at a detailed level were the participant's lunch hours and private meetings where the participant requested that the researcher not attend (Charles requested that the researcher not attend one internal staff meeting due to his belief about the sensitivity of the topics to be discussed). These minute-level notes were captured for 875 minutes (14.5 hours) with Charles and 1017 minutes (17 hours) with Sam across two separate work days each.

The columns labeled Activity A, B, and C designates that for any given event in a particular time segment, participants were simultaneously engaged in one or more additional activities (not necessarily related to the first activity). Segments where nothing is recorded (e.g. 10:12 below) indicate that the activity from the time stamp above continued or ended "—–".

Time	**Activity A**	**Activity B**	**Activity C**
10:08	Opening a parcel that contains a small computer	Small talk with researcher	
10:09	Using bug tracking tool on left monitor	E-mail browser open on right monitor	
10:10	Leaves cube to go get a coffee (down the hallway)	—–	
10:11	Turns on a laptop that is sitting to the left of the desk	Glancing over a project overview document on right monitor	Simultaneously glancing at bug tracking tool on right
10:12	—–		
10:13	Goes to corporate intranet and submits an electronic approval for vacation days on left monitor	A new e-mail notification pop up window appears (and then automatically disappears) in lower right of left monitor	

Table 12: Example Time Log Segment for Case Site Participant.

The underlying purpose for capturing to-the-minute notations of the participants' cubicle activities was to gather baseline data for how the participant worked. From an understanding of the participant's typical way of managing his activities when working alone, an analysis comparing how he multitasks and manages himself in face-to-face group meetings is possible. This comparison is useful for assessing how work behaviors changed across different office settings. This baseline focused on the following themes which are all related to the larger research aims on technology multitasking:

- Communication
    - Who do they communicate with during the day? Via what methods and for how long?
    - How often is e-mail checked? How quickly do they respond to messages?
- Work Tasks
    - Which work tasks are completed simultaneously?
    - Are there activities that they devote full attention to?
    - How long do they spend on different work tasks?
- Technologies
    - Which software/web applications do they use? How many windows are open on their computers?
    - How many different technologies (phone, computers, etc.) are used throughout the day?
- Organization of Activity
    - How does the participant keep track of their schedule?
    - How do they decide what to work on next?
- Interruptions
    - How many people stop by to ask questions? How often do they get up to ask someone a question?
    - How often does the phone ring?
    - Do they self-interrupt and lose track of what they are working on?

The data gathered on these themes are presented in the Participant Results section which follows immediately after the following overview for how meeting observations were conducted.

Observations of Participant in Meetings

For each of the seven (7) face-to-face meetings the researcher attended with the two SoftwareCorp participants she was positioned at the conference table next to the participant for five meetings, and just behind the participant against a wall for two meetings. Figure 8 shows the conference table configuration for two meetings as an example.

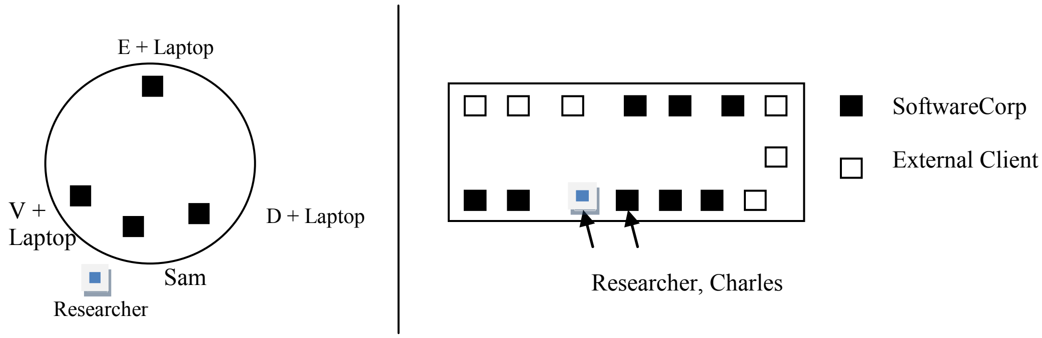

Figure 8: Two Different Conference Room Configurations.

The other meeting attendees were informed prior to the commencement of the meeting that the researcher was present to observe the meeting for a university project on technology use in the workplace. While the researcher kept her observations primarily about Charles or Sam, any time another meeting attendee multitasked with technology this was also captured in the data time logs. One of the shortcomings with data collection during these meetings is that when 3 or more individuals were multitasking simultaneously, it was difficult to accurately capture the start and end times of their activity. Also, it was not possible for the researcher to see everyone's laptop screen during a meeting which limited the identification of multitasking for private versus group-oriented tasks. However, since the main observational focus was Charles and Sam, these limitations do not detract from the main findings.

An additional feature of the meeting time logs is the capturing of conversation activity. This means that not only did the researcher observe and notate the activities of Charles and Sam during the meeting, but also the topic being discussed and by whom for any given minute segment. The purpose of capturing the meeting conversation was to create an analysis of the data that linked the meeting activity to any technology multitasking that may have been occurring at the same time.

Participant Results

The case study results begin with an analysis of how Charles and Sam worked alone in their cubicles. This baseline data for how the participants worked alone is then compared to technology multitasking behaviors when working with others in team meetings. To create this comparison, an in-depth examination of mixed reality meetings at SoftwareCorp is discussed across three different themes drawing from the behaviors observed and discussed with the participants.

Baseline Data in Cubicle (Working Alone)

The first observation that struck the researcher upon comparing Charles's and Sam's cubicle spaces was the general organization of artifacts. Sam is a "piler" with scraps of paper and documents, food containers, books and office supplies all over his main desk and the desk behind him—there is no apparent organization to the piles. Charles's cube has some office supplies and documents by his keyboard, but overall the work space is sparse and not filled with anything extraneous.

When at their desks, both Charles and Sam face their two monitors and complete most work tasks on the computer. The computers operate on a Windows operating system, and the primary work applications used are Microsoft Outlook for e-mail, calendar, and meeting scheduling, Yahoo Instant Messenger for instant messaging, and Mozilla Firefox for web browsing. Sam's main computing tasks involve communicating and corresponding via e-mail, responding to instant messages, using SoftwareCorp's web-based company intranet to complete management tasks (e.g. approving time off and performance evaluations), and editing information in the web-based software bug tracking tool. Charles's main tasks also rely on e-mail and instant messaging throughout the day, but his other major work task involves creating PowerPoint presentations and researching information to support his business development efforts with enterprise clients. Excluding times when they are in meetings, on the telephone, or talking to someone in-person, both Charles and Sam spend their entire workday using the computer.

Noise and Interruptions to Cubicle Work

The level of noise in their cubicles from walk-by traffic and other people working from adjoining cubicles was minimal. Office noise can be disruptive and lead to tension amongst employees. Evans & Johnson (2000) conducted an experimental study with clerical workers by manipulating the level of random office noise and found that participants in the noisy condition experienced greater levels of stress. Across the four job shadowing days, each participant could overhear someone else's phone conversation (coming from another cubicle) once per day for 10 minutes or less.

While there was minimal office noise, the few noises that did occur were noticed by both participants because the researcher observed their head move toward the noise each time. The sounds of shuffling papers, typing, someone walking by, or office conversations were indicators of who else was present. The researcher observed that when footsteps could be heard, both participants would look up from their computers momentarily as they quickly scanned the area to see if they could identify who was passing by. For example, Sam noticed a co-worker walking past his cube and said out loud, "Hey, did you send me that instant message?" Also, if nearby cubicle mates were known to be at their desks, Charles and Sam sometimes just talked loudly across the cubicles to converse. Knowing who else was in the office was useful for determining to what extent one could interact with other colleagues (e.g. walking over to have a conversation with someone might be more effective than instant messaging, or vice versa).

Stop by interruptions (people going to Charles's or Sam's cubicle to ask a quick question) usually lasted about one-minute, though Charles did have two stop bys that lasted 6 to 10 minutes, and Sam had two that lasted 6 to 7 minutes. The purpose of the stop bys was predominantly work related where someone needed an answer to a question, though sometimes they served a social function for people just to say hello or ask how someone was doing. Sam encountered more interruptions from people coming by his cube to ask a question than Charles: Sam had 18 stop bys across the 2 days of observation while Charles had 9 stop bys. This difference is most likely attributable to the fact that Sam manages a larger team of people on-site.

While Sam and Charles were job shadowed, on average, for just under 8 hours each day (mean minutes job shadowed per day = 473), the majority of their days were spent working with other people in the form of either scheduled meetings or stop by interruptions. A time break-down of each job shadowing day is shown in Table 13, and as can be seen in the last row, Sam and Charles typically had about 2 hours of their work day in which they were not actively communicating with others and were working alone. Day 2 with Sam, where he had 274 minutes (about 4.5 hours) of time to work alone was unusual. Sam's 4.5 hours of working alone time was higher than normal because this was the first work day of the new calendar year following a holiday break of nearly two weeks. Sam explained to the researcher that this work day had been unusually quiet and he believed it was because of the vacation break.

	Sam		Charles	
Activity Breakdown (Minutes)	**Day 1 (10/29/08)**	**Day 2 (01/05/09)**	**Day 1 (10/30/08)**	**Day 2 (12/11/08)**
Job Shadow Time Length	501	516	408	467
Stop by Interruptions	11	18	12	11
Conference Calls	96	0	59	123
F2F Group Meetings	119	78	233	192
One-on-One Meetings	159	146	0	0
Working Alone in Cubicle	**116**	**274**	**104**	**141**

Table 13: Time Spent Working Alone vs. Spent Working with Others.

The implication of the table above suggests that time spent working alone is about 2 hours for a typical work day. This 2 hours of working alone time is not continuous, it is interspersed between the time spent working with others. Excluding the outlier day (Sam – Day 2) approximately 75% of their work is spent communicating or collaborating with coworkers. One possible consequence of this time usage is that Charles and Sam must find ways to monitor e-mail and instant messages while simultaneously participating in other work activities (such as meetings). If participants used only e-mail and instant messaging when they were working alone, they would not be accessible with enough frequency to help manage and assist on their respective projects.

Participant Work Styles

During the time that they are working alone, Sam kept 20 or more windows open which are layered on top of each other and there are about 10 "tabs" on the bottom of his monitor showing the different open applications. Sam constantly shifted windows around and opened more—it was sometimes difficult to keep track of what he was doing at any given moment because he shifted very quickly between tasks (and it appeared that he was working on multiple different tasks at the same time too). For example, Sam would quickly write an e-mail (less than 30 seconds), and seemingly simultaneously looked up information on a web site (unrelated to the e-mail) and scanned his e-mail for new messages. The researcher was able to distinguish that tasks were unrelated based on the following: (1) reading the on-screen text, (2) Sam's use of two different instant messaging clients (one was for personal use), (3) Sam's use of a separate e-mail client for personal communication, and (4) verifying with Sam at the end of the day that he completed distinct tasks nearly simultaneously throughout the day.

Whenever a new e-mail message arrived, it notified Sam with a pop-up in the lower right of his left monitor, and typically Sam stopped whatever he was working on to open that message and respond to it immediately. Instant messages were also responded to immediately. There was a continuous flurry of layered activities and tasks when watching Sam work. The researcher confirmed with Sam at the end of his work day that this pattern of interleaving multiple work tasks was typical for him.

Charles, on the other hand, worked in a more linear manner; it was easy to identify in any given moment his primary work task. Charles avoided working on different projects at the same time and limited interference to his current work task. For example, he would wait until he was at a natural stopping point in his current task before checking new e-mail messages. And, where Sam had 20 windows layered on top of each other across two monitors, Charles rarely had more than 3 windows open at any time, and he would close them as soon as he was finished.

In Table 14 and Table 15, a summary of Sam's and Charles's work days are summarized from the event log data. Day 1 of observations is shown for Sam, and Day 2 for Charles, since these were the work days deemed "most typical" by the participants. For completeness, the other two observation logs (for the "less busy" days) are shown in Appendix F. Each row represents 30 minutes of time and the main tasks accomplished during that segment. For example, from 11:00-11:30am, Sam primarily wrote e-mails and used the company intranet site to complete other work tasks (e.g. approving vacation time off). The primary task was determined by the length of time spent on that activity. Even though a single tool, like e-mail, might be used for the majority of the time segment, each time the tool was used for a new a task unrelated to the previous activity, it was counted as a task change (last column). In the first 30 minutes of the work day, Sam had 8 task changes. Examination of the tasks in this manner follows Gonzalez & Mark's (2004) notion of a "working sphere" which is a set of interrelated events that share a common purpose but rely on multiple different resources and communication modes. This enumeration of task changing provides empirical support for the researcher's observations that Sam's work style interleaved unrelated tasks more often than Charles.

Time Segment	**Location**	**Primary Task**	**Secondary**	**Tertiary**	**Task Changes**
10:00-10:30	Desk	E-mail			8
10:30-11:00	Desk	E-mail	Conference Call		6
11:00-11:30	Desk	E-mail	Management Tasks on Intranet		7
11:30-12:00	Desk	E-mail			4
12:00-12:30	Off-Site	Lunch			——
12:30-1:00	Off-Site	Lunch			——
1:00-1:30	Conference Room	Meeting Participant	Multitasking on Laptop		——
1:30-2:00	Conference Room	Meeting Participant	Multitasking on Laptop		——
2:00-2:30	Desk	Bug Scrub	E-mail		5
2:30-3:00	Desk	Bug Scrub			3
3:00-3:30	Conference Room	Meeting Leader			——
3:30-4:00	Conference Room	Meeting Leader			——
4:00-4:30	Desk	Bug Scrub	E-mail		2
4:30-5:00	Desk	Bug Scrub	E-mail		4
5:00-5:30	Desk	E-mail	Conference Call		7
5:30-6:00	Desk	E-mail	Conference Call		3
6:00-6:30	Desk	Break from work, talking with researcher			——

6:30-7:00	Coworker's Desk	Bug Scrub			——
7:00-7:30	Coworker's Desk	Bug Scrub			——
7:30-8:00	Desk	E-mail			3

Table 14: Sam's Time/Task Log for Day 1.

Time Segment	**Location**	**Primary Task**	**Secondary**	**Tertiary**	**Task Changes**
8:00-8:30	Desk	E-mail			2
8:30-9:00	Desk	Conference Call	E-mail	Instant Messaging	4
9:00-9:30	Desk	Conference Call	E-mail	Instant Messaging	4
9:30-10:00	Desk	E-mail	Phone	Instant Messaging	3
10:00-10:30	Conference Room	Meeting Participant			——
10:30-11:00	Conference Room	Meeting Participant			——
11:00-11:30	Conference Room	Meeting Participant	Multitasking on Laptop		——
11:30-12:00	Conference Room	Meeting Participant	Multitasking on Laptop		——
12:00-12:30	Off-Site	Lunch			——
12:30-1:00	Off-Site	Lunch			——
1:00-1:30	Desk	Phone	Conference Call	Instant Messaging	4
1:30-2:00	Desk	Conference Call	E-mail	Instant Messaging	3
2:00-2:30	Desk	Stop by Interruption	Phone	E-mail	4
2:30-3:00	Desk	Conference Call	E-mail	Instant Messaging	5
3:00-3:30	Desk	E-mail	Bug Track	Conference Call	5
3:30-4:00	Desk	E-mail	1:1 Conversation		4
4:00-4:30	Conference Room	Meeting Participant			——
4:30-5:00	Conference Room	Meeting participant			——
5:00-5:30	Conference Room	Meeting Participant			——

Table 15: Charles's Time/Task Log for Day 2.

In summary, Charles and Sam have distinct work styles from each other. Charles manifested little clutter at his desk and on his computer work space, and he made an effort to minimize distractions (such as closing out applications immediately and only checking e-mail at natural break points during his work). Sam's work style, on the other hand, is filled with constant layers of different activities. Sam does not devote time segments to single tasks, but instead maintains a constant ebb and flow across multiple unrelated activities throughout his day. Even when Sam purposefully focused his work on more attention-intensive work tasks (e.g. his "bug scrubs" where he had to review technical problems and decide how to address the issue), he continued to check e-mail and write instant messages. The next section addresses how this working alone style compared to their behaviors in group meetings.

Comparison Analysis of SoftwareCorp Mixed Reality Meetings

How did participant work styles change between working alone compared to amongst other people? The theory of social facilitation (Zajonc, 1965) states that when people perform a task in the presence of others, arousal increases. For simple tasks, this arousal leads to improved performance; for complex tasks, this arousal is detrimental. Just being merely present in front of others changes our actions because individuals shift into a performance mode where they purposefully modify their behavior based on how they want to be perceived by others (see Chapter 2 discussion on Goffman and impression management).

Based on the prior description of how the participants worked alone, the researcher anticipated that Charles would multitask in meetings minimally, if at all, and that Sam would have a propensity for technology multitasking. In Table 16 and Table 17, the seven (7) face-to-face meetings observed with Sam and Charles are summarized. In the first table below, Sam had two Internal Project Meetings and two Staff Meetings across the observation days. In both instances the people attending each of these meeting types were the same, meaning that both Staff Meetings involved the same set of attendees (Sam's team of engineers), and both Internal Project Meetings were attended by the same members (product managers and technical leads). The column "Types of Laptop Use" combines observations from any multitasking with technology that the researcher observed from her field of view.

During the observations of meetings with Charles, he had one half-day long meeting on the first observation day with external clients visiting at SoftwareCorp, and then two Internal Project Meetings with two different teams on the second day. The meetings observed with the SoftwareCorp participants are reflective of typical meetings the participants had each week. The researcher verified that these were typical meetings by asking Charles and Sam how common each meeting had been for their regular work week.

Meeting Type	# of F2F Attendees	# People Dialed-in	Meeting Length	# of Laptops in Meeting	Types of Laptop Use
Internal Project Meeting DAY 1	4	2	1 hour	2	-IM another colleague to see if he could attend the meeting -Taking electronic meeting notes -Electronic calendar for scheduling
Staff Meeting DAY 1	7	0	1 hour	1	-Showing a PowerPoint presentation
Internal Project Meeting DAY 2	6	5	1 hour	5	-Taking electronic meeting notes -Checking e-mail and instant messages throughout entire meeting
Staff Meeting DAY 2	8	0	30 minutes	1	-Not used during meeting

Table 16: Overview of Sam's Meetings at SoftwareCorp.

Meeting Type	# of F2F Attendees	# People Dialed-in	Meeting Length	# of Laptops in Meeting	Types of Laptop Use
External Client Meeting DAY 1	14	0	4 hours	14	-Taking electronic meeting notes -Showing a PowerPoint presentation -Electronic calendar for scheduling -Looking up information to share with the meeting -Checking e-mail for other work reasons -Sending/receiving IMs for other work reasons
Internal Project Meeting DAY 2	12	5	1 ½ hours	5	-Checking e-mail and instant messages throughout entire meeting
Internal Project Meeting DAY 2	13	0	1 ½ hours	5	-Checking e-mail Reviewing the presentation being projected

Table 17: Overview of Charles's Meetings at SoftwareCorp.

These meetings are explored in the next sections following the three themes presented earlier in the chapter. Charles's and Sam's meetings are analyzed in the context of what led to their technology multitasking (Theme 1), their behaviors and attitudes during the meeting (Theme 2) and perception of mixed reality's impacts (Theme 3).

FACTORS CONTRIBUTING TO TECHNOLOGY MULTITASKING (THEME 1)

In this section, the factors contributing to the likelihood to multitask with technology in meetings is presented. Based on the conceptual model (see Figure 4, p. 90) the role of meeting type and polychronicity were anticipated to impact the likelihood to multitask.

Meeting Type & Likelihood to Multitask

Meeting type correlated with how and why participants multitasked with laptops. Meetings which were based around work projects (project meetings) exhibited frequent levels of multitasking compared to meetings that were meant to facilitate team building and general status updates (staff meetings). Both Charles and Sam multitasked during project meetings, but not in their staff meetings.

Staff Meetings

In staff meetings, laptop use did not occur except for presentations. The researcher observed three main purposes for staff meetings: to relay team updates, plan social activities (e.g. group lunches) and share general project or staffing information amongst the group. Sam led his 1-hour staff meetings which were attended by the developers who report to him. In each of the two staff meetings observed, Sam would begin the meeting with introductory comments about the current state of the project (approximately 20-30 minutes), and then each of the developers would take their turn giving an update (30 minutes).

When the researcher asked Sam if anyone in the staff meeting ever multitasked during the meeting, Sam explained that no one did. The goal of the staff meeting was to learn about each other's work status and share information that would be relevant to everyone in the room, there would be no plausible reason for any of the developers to be using a laptop.

Charles attended one staff meeting, but the researcher was not in attendance due to the sensitivity of the topics being discussed. However, the researcher questioned Charles afterwards about the general topics discussed and if any technology multitasking occurred (none did as reported by Charles). Similar to Sam's staff meetings, Charles explained that "there would be no reason to have a laptop in this meeting." In contrast to the staff meetings, internal project meetings exhibited frequent technology multitasking by both participants.

Internal Project Meetings

For internal project meetings, the purpose was to share information and plan specific aspects of the software projects. In Sam's internal project meeting on Day 1, the group set deadlines for the project and negotiated whether more staff could be hired. The format of the meeting followed an agenda that had been sent out previously by the meeting leader; each meeting topic discussed followed the outline on the agenda.

In this meeting there were four people (of which two had laptops) in the conference room and two people dialed-in on the teleconference system. One laptop was the facilitator's, and he multitasked sparingly (for example, looking up a schedule date related to the meeting). By nature of his role, the meeting facilitator could not use the laptop with great frequency because his main task was to keep the meeting on topic and organize/recap each of the agenda items. The facilitator's meeting responsibilities were determined by observing him in two staff meetings where he conducted both meetings in the same manner and verifying how typical his behavior was by asking him later in the day about his role in the meeting.

The second laptop was used by Sam's boss, the Director of Engineering, who multitasked throughout the entire meeting. It was not possible from the researcher's vantage point to see the Director's laptop screen. However, it was possible to observe where the Director's eyes were focused, and if his hands were typing or using the mouse on the laptop. His laptop use did not seem to interfere with his meeting participation—when the Director had something to say, he would lean forward and close his laptop slightly and speak, but then return to technology multitasking immediately.

Figure 9 below shows a figurative graph representing the researcher's observations of the Director's technology multitasking in relation to his meeting participation. The x-axis on the graph represents the meeting time, from 3:06pm is when the Director started using his laptop, and he continued until 3:48pm. Every time the researcher could hear or see the Director typing on his laptop or observe his eyes focused on the laptop screen, she notated the start and end time. Similarly, when the Director participated in the meeting conversation, this too was notated. On the graph, technology multitasking is represented as an "o" and the moments when the Director talked in the meeting is shown as an "x". As shown below, the Director interspersed his technology multitasking and meeting participation.

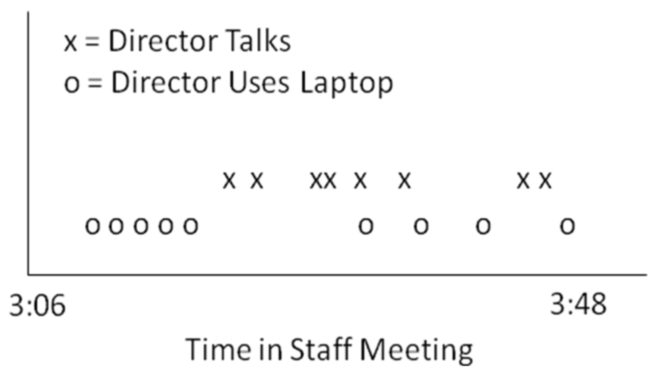

Figure 9: Figurative Graph of Technology Multitasking in Project Meeting.

While the meeting facilitator and the Director both used their laptops during the meeting, Sam did not multitask though it was anticipated that he normally would for this specific meeting. Sam later explained to the researcher that based on a conversation he and the Director had previously, Sam felt there was an expectation for him to participate and lead the decision making in this meeting. Therefore, Sam believed it was prudent for him not to be multitasking while the Director was present in order to demonstrate that he was taking a more active role. Observations of Sam's technology multitasking during the second instance of this same weekly internal project meeting are discussed further in the next section with Theme 2 results.

External Project Meetings

On the first day of observations with Charles, a 14-person external project meeting was held that lasted four hours and exhibited technology multitasking behaviors. This meeting with Charles was part of a 2-day set of events with a major client (this client is a Fortune 100 information technology/software company). About half the people in this meeting were the client and the other half were from SoftwareCorp. The purpose of this meeting was to learn more about the client's software needs and specifically Charles was there to give a presentation about new features of the software. Everyone in this meeting had a laptop in front of them, though at any given point in the meeting only about half the laptops were open. While some of the people in the room had worked together over the course of the business relationship, most of the attendees did not know each other and everyone worked at different office locations around the US. The format of the meeting consisted of sets of presentations and discussions, some led by SoftwareCorp and some led by the client.

In the first 15 minutes of the meeting when introductions took place, no one used their laptop and people focused their gaze at the speaker (each person took a turn giving a brief description of themselves and her or his role). The client was the first to begin the meeting discussion as they presented the current state of their workplace issues that related to SoftwareCorp's product solution. During the client's presentation Charles took electronic meeting notes in an e-mail message to himself—these notes were brief one line comments. He took five lines of notes in the first hour. While 7 laptops were open during this time of the meeting, no one was actively engaged with their laptops; people would glance at their laptop, or type something quickly, but laptops were not used for any prolonged period of time. People also occasionally peeked at their mobile phones during this same time period, but these behaviors were subtle and quick.

For the next section of the meeting where Charles stood in front of the room and presented, a shift in laptop use occurred. Charles's assistant product manager, Eric (pseudonym), began to use his laptop with intensity. The researcher was sitting next to Eric at the table and was able to observe all of his technology multitasking. Previously when the client had been speaking, Eric had not used his laptop except for an occasional glance to see if new e-mail messages had arrived. Now during Charles's presentation, Eric was writing and reading e-mails in addition to corresponding with people via instant messaging for periods of time lasting up to 5 minutes. During the lunch break, Eric explained that the change in his laptop use was because he knew everything that Charles was going to be presenting, therefore he felt comfortable using his laptop at that point. Also, he clarified that he did not use his laptop while the client was speaking because he wanted to hear what the client had to say.

When the meeting recommenced after a lunch break, there were 5 people (a combination of both SoftwareCorp and the client) who were using their laptops in a focused manner. With focused use, every time the researcher would glance around the room, it was observed that their eyes were still intently gazing at the technology and not at whoever was speaking. Charles was still in the front of the room presenting during this time. After the meeting, Charles explained to the researcher that the focused laptop use had not bothered him. He explained that some of the clients in attendance were involved with high level strategy and some were developers who were more focused on the project details. These different role types had dissimilar information needs in the meeting;

therefore technology multitasking did not bother him because parts of his presentation were only pertinent to some of the attendees.

Overall, for the face-to-face meetings observed, there were no instances where laptops caused any major disruption to the meeting. No one in the meeting ever made a verbal comment about people's technology multitasking and when Charles debriefed the researcher about his feelings toward multitasking in the meeting, he stated that the behaviors in the meeting had been typical and that the meeting had run smoothly. In fact, the laptop was a positive supplemental tool to help record notes and look up information that facilitated the meeting. When people did use their laptop for non-meeting reasons, they limited it to when they were not needed in the meeting or when the meeting was on break. People seemed to self-regulate their use of technology to fit the social and task needs of the group as appropriate. When the meeting purpose was to share information at a high level (staff meetings), laptops were not brought or used. When the meeting was a "working meeting" (internal/external project meetings), laptops were brought to the meeting by at least half the attendees, and varying levels of technology multitasking occurred and were viewed as a normal occurrence by participants.

Polychronicity & Likelihood to Multitask

The second factor analyzed as an influence on the likelihood to multitask with technology is polychronicity. Polychronicity is one's preference for multitasking and belief that this is the best way to work. Charles scored a 15 and Sam a 26 on the Polychronic-Monochronic Tendency Scale. A higher score on the PMTS (theoretical range of 5-35) equates to a greater preference for multitasking. Despite differing scores for polychronicity, both Charles and Sam multitasked with laptops during meetings.

When their technology multitasking deviated from their normal practice, it was based on who else was present in the meeting or the role they needed to take in the meeting.

Sam is high in polychronicity but did not bring a laptop to a meeting where his boss (the Director discussed in the previous section) was present because “he’s expecting me to lead the decision making” meaning that Sam wanted to demonstrate engagement and focus in the meeting by not multitasking. And, while Sam brought his laptop to the staff meeting, he did so only to show a PowerPoint presentation. Since Sam was the leader for the staff meeting, it would have been difficult to both facilitate the meeting while multitasking with other work tasks. However, when Sam was in internal project meetings (without his boss present), he multitasked continuously throughout the meeting (see Table 18 for an event log of Sam’s frequency of laptop use in this meeting). The researcher verified with Sam that his multitasking behavior without the boss was typical for him during project meetings.

Charles, who is lower in polychronicity than Sam, brought his laptop to the external project meeting and used it to take meeting notes and during breaks he would check e-mail. Charles also multitasked with his laptop during internal project meetings but did not use it during staff meetings. With these participants, a preference for multitasking as measured by polychronicity, did not seem to account for whether one technology multitasked in meetings since Charles’s polychronicity score was 15 and Sam’s 26, yet both engaged in similar meeting behaviors.

Recalling each participant’s work behavior when at their desks, Sam completed his work by interleaving multiple different tasks together in the same time period and Charles exhibited a linear work style where each time segment was focused on one main task. Their respective work styles are similarly reflected in how they multitasked. Sam used his laptop to check e-mails and write instant messages throughout his second internal project meeting, and these activities were not necessarily related to the meeting conversation (as verified by asking Sam). Charles, on the other hand, only used his laptop during meeting discussions to supplement the meeting task (e.g. by taking electronic meeting notes). He would multitask with non-meeting tasks only during breaks. Based on these participants, polychronicity reflected willingness to work on unrelated (non-meeting) tasks simultaneously, but not one's likelihood to multitask in meetings in general. These meeting behaviors are examined further in the next section as the mechanisms of copresence and cohesion beliefs are discussed.

BEHAVIORS & ATTITUDES IN MIXED REALITY (THEME 2)

Copresence Management

Copresence management as defined in this research is the mix of verbal and non-verbal signals people use to indicate to others that they are paying attention and are available for communication (either with individuals in the same room, or electronic communication partners). One of the first instances of copresence management observed was during the external project meeting with Charles. The researcher noted that each time someone looked up after having used their laptop, their gaze went immediately to whomever was speaking. For each instance that the researcher was watching someone technology multitasking, she recorded where their focus of visual attention went after the person looked up from their laptop. This behavior was noted approximately 20 times across two hours of the external project meeting (7 attendees out of 14 had their laptops open for use during this time period).

Gaze is an essential non-verbal behavior that directs the conversational flow, influencing who keeps or takes the next speaking turn and who avoids it (Kendon, 1967).

This observation suggests that people may unconsciously try to re-engage into the face-to-face activity after multitasking on their laptop. The other hypothetical points of visual focus would be scanning all group members, looking off into space/down toward the floor and focusing on another group member who was not currently speaking. Since participants specifically gazed at the speaker after multitasking, people appear to want to re-engage with the current conversational space.

While multitasking during meetings, participants did not try and minimize their electronic availability. For example, neither Charles nor Sam changed their instant messaging status (e.g. "I'm away/I'm busy") and they did not close their e-mail programs. In fact, besides Charles's note taking, maintaining electronic copresence was one of the key reasons to use a laptop during a meeting. Both participants responded to incoming instant messages during meetings, and Sam would check his e-mail with the same frequency as when he was working from his cubicle.

Copresence management was a behavior exhibited by all participants who technology multitasked. Based on the observations of gaze, multitaskers demonstrated that they were still a part of the meeting conversation by focusing their attention on whoever was speaking immediately after they finished using their laptop. However, multitaskers also chose to maintain their availability and communicate with others outside of the meeting too. Laptops facilitated people's ability to sustain a presence with other co-workers despite being physically contained in the meeting space.

Cohesion Beliefs & Technology Multitasking

Cohesion is a combination of two factors: social liking amongst group members and commitment to the work task. Based on the understanding of cohesion developed from the literature review, it was anticipated that social liking amongst group members would lead to decreases in multitasking since group members in cohesive teams would want to demonstrate increased engagement with collocated members. However, social cohesion did not affect how participants multitasked during meetings, but task cohesion did. The observational data from SoftwareCorp explores how these two factors had distinct impacts on technology multitasking.

Neither social nor task aspects of cohesion affected the way Sam typically used his laptop during internal project meetings (his lack of multitasking when his boss was present was atypical). Sam's second internal project meeting was highly relevant to him and there was high social liking (Sam had lunch with the meeting leader for multiple times each week and they socialized together outside of work). During this meeting, Sam multitasked frequently while still participating in the group discussion. Table 18 below shows each minute of Sam's behavior from 1:00pm to 1:41pm. Segments of the table that are highlighted in gray represent the minutes in the meeting where Sam was talking out loud. There are significantly more minute segments where Sam is technology multitasking than he is talking out loud (29 minutes using laptop, 13 minutes talking). Sam described his technology multitasking behavior as being typical for him, and he did not believe that anyone else in the meeting was bothered by his behavior.

Sam's belief that his multitasking was accepted seems plausible based on the behavior of the other group members toward Sam during the meeting. The researcher observed that when the meeting leader was anticipating asking a question of Sam, the leader turned his body toward Sam, and while still talking, looked at Sam for 5 seconds before asking his question (Sam's focus was toward his laptop). While the meeting leader used gaze to give Sam an indication that he would be speaking toward him, the other meeting attendees simply used Sam's name out loud as a preface to their question and did not use any other signals.

1:00	Sam sitting in meeting with laptop open, an IM arrives	1:21	An instant message arrives on Sam's laptop, he writes back immediately
1:01	Sam looking at his laptop	1:22	Sam back to e-mail
1:02	Sam adjust a setting on his laptop's wireless network	1:23	Sam continuing to use e-mail
1:03	Sam opens up his e-mail client	1:24	Sam talks in the meeting
1:04	Sam writing an instant message while meeting leader talks	1:25	Another instant message arrives on Sam's laptop
1:05	Sam browsing his e-mails	1:26	Sam writing instant messages
1:06	Sam continuing to use e-mail	1:27	Sam talking in meeting
1:07	Sam continuing to use e-mail	1:28	Sam talking in meeting
1:08	Sam continuing to use e-mail	1:29	Sam talking in meeting
1:09	Sam continuing to use e-mail	1:30	Sam talking in meeting
1:10	Sam continuing to use e-mail	1:31	Sam talking in meeting
1:11	Sam talks in meeting, answering a question from meeting leader	1:32	Sam goes back to checking e-mail
1:12	Sam talks	1:33	Sam receives a new instant message and replies
1:13	Sam talks, his eyes glance at his laptop as a new e-mail arrives	1:34	Sam continuing to use instant messaging
1:14	Back and forth meeting discussion between Sam and other attendees	1:35	Sam continuing to use instant messaging
1:15	Back and forth meeting discussion between Sam and other attendees	1:36	Sam checking e-mail
1:16	Sam back to checking e-mail	1:37	Sam checking e-mail
1:17	Sam continuing to use e-mail	1:38	Sam checking e-mail
1:18	Sam continuing to use e-mail	1:39	Sam checking e-mail
1:19	Sam answers another question in the meeting	1:40	Sam checking e-mail
1:20	Sam opens up the bug tracking tool and uses information from the program to answer a meeting question	1:41	Sam checking e-mail

Table 18: Sam's Technology Multitasking Timeline in a Project Meeting.

While cohesion beliefs did not change Sam's technology multitasking, the task aspect of cohesion did affect behaviors in Charles's internal project meeting. The purpose of Charles's meeting was to discuss the launch of a new version of the software product. During the first thirty minutes of this meeting, 5 out of 13 people used their laptops in short bursts every few minutes. However, laptop use amongst all 5 of these people significantly changed as the meeting discussion turned serious. Critical issues were discovered about the product that resulted in a heated discussion about whether the product could be launched the next day or not. Once the meeting topic became significant, laptop use ceased and all meeting attendees were actively engaged in the group discussion and no longer technology multitasking.

From the observations of meetings at SoftwareCorp, cohesion beliefs have an unclear impact on technology multitasking. Sam was highly committed to his project meeting and liked the other members of the team, yet he spent most of his time in the meeting checking e-mail. As task relevance of the meeting increased with Charles's team, it resulted in a shift from technology multitasking behavior to complete focus on the group discussion. These results suggest that social liking and task factors may not influence technology multitasking in the same manner. Task relevance, especially in critical contexts, seems to influence behavior more so than social liking.

OUTCOMES FROM MIXED REALITY (THEME 3)

Did the SoftwareCorp participants find meetings more productive and satisfying when they could multitask with technology? Charles and Sam did not express strong attitudes toward being able to multitask during meetings. Technology multitasking was viewed by both as a normal work behavior and neither voiced opinions about whether they felt more accomplished in meetings when they could use laptops.

Since Charles and Sam always brought a laptop to meetings (except staff meetings), this suggests that technology multitasking was a preferred behavior by both participants. During the fieldwork period, there were no formal rules at SoftwareCorp encouraging or discouraging technology multitasking in meetings. However, Charles told the researcher that at least two times previously in the past year, a senior vice-president at the company had mandated that laptop use in meetings cease. Charles described how this rule would be brought up in a company-wide meeting, but that people eventually just started using their laptops again and the rule was forgotten. While at a high-level, organizational leaders at SoftwareCorp made attempts to ban technology multitasking, in daily practice the behavior was viewed as a normal and necessary part of meetings. Considering this normalcy surrounding the behavior and the fact that Charles and Sam seemed unperturbed by mixed reality, the researcher questioned how well they observed the multitasking behaviors of others. The purpose in trying to identify the extent to which Charles and Sam noticed other's multitasking was to assess whether mixed reality behaviors left a memorable impression. If mixed reality behaviors are unnoticed, this suggests that technology multitasking has no impact on other team members.

The researcher tested how perceptive the participants were toward other people's technology multitasking on the second day of observations. Charles and Sam were asked at the end of their work day to describe how other people in the meetings that day had used their laptops. The purpose of this line of questioning was to gather data about Charles's and Sam's awareness of technology multitasking. Had they noticed who else was using a laptop in the meeting? If so, could they identify what that person had used her or his laptop for during the meeting?

These questions were purposefully asked on the last day of observations when neither participant was expecting to be questioned on what other people had done during the meeting. The researcher anticipated that neither participant would be able to answer these questions, but this assumption was incorrect. When Charles was asked to identify who had used a laptop during his internal project meeting, he was able to name each person. Furthermore, when asked to describe for what tasks the laptop had been used, he described the other's activities based on the sounds of their typing during the meeting.

> *Charles: Well, I think Linda was writing IMs [instant messages] and browsing the web. She was writing IMs because I could hear the sounds of fast typing. If she was writing e-mail, the typing would be slower.*

Sam was also able to name each person who had been using a laptop during his meetings. However, Sam's identification of laptop use was not based on sounds, but rather his familiarity with the person's multitasking behavior in general. Sam explained that he thought the two people in the meeting using laptops were checking e-mail because "that's what they usually do in meetings." While mixed reality meetings were routine for Charles and Sam, they had difficulty verbalizing whether they were more satisfied or productive in meetings because of it. However, the technology multitasking behaviors of others did not go unnoticed. The fact that Charles and Sam were cognizant of others multitasking behaviors indicates that mixed has the potential to impact other individuals.

Case Study Results Summary

From the observations and discussions with Charles and Sam at SoftwareCorp, multitasking with technology is common across the majority of face-to-face meeting types except for staff meetings. Despite differing polychronicity scores, both Charles and Sam multitasked with their laptops, modifying their behavior when they believed it might be perceived as disruptive or when they needed to concentrate more on the meeting at hand. Sam tended to multitask during internal project meetings more frequently than Charles and his multitasking was continuous throughout the entire meeting (while simultaneously participating in the meeting). Charles, on the other hand, generally limited his multitasking to segments of meetings where he felt his participation was not necessary. With the data gathered thus far, polychronicity does not seem to be a strong indicator of whether one decides to technology multitask in meetings or not (since Charles multitasked in the same types of meetings as Sam), but does reflect the willingness of participants to multitask on unrelated tasks.

Sam maintained continuous copresence with electronic communication partners throughout meetings where he multitasked. If an instant message or e-mail arrived, he would respond to it immediately. Sam's copresence management with his collocated teammates was non-existent. While he was an active contributor to the meeting, even when multitasking, Sam did not make an effort to look up from his laptop screen until he was speaking. Charles was more conscientious about his copresence with those in the meeting room. He mainly multitasked with tasks relevant to the meeting (e.g. meeting notes) and used his laptop sparingly for e-mail.

The two factors of cohesion, social and task, impacted technology multitasking differently across meetings. Despite having strong social liking and high task relevance in his internal project meetings, Sam multitasked frequently. However, task relevance was shown to disrupt multitasking behaviors in Charles's meeting when the topic of discussion was deemed to be of great import by participants. In summary, mixed reality meetings at SoftwareCorp were common and neither Sam nor Charles reported it disruptive for others to be multitasking. The next section discusses these same themes with the addition of data from eight other information workers from different corporations.

FOCUSED ONE-ON-ONE INTERVIEW SUMMARY

Eight participants from eight unique companies were interviewed for one-hour in a face-to-face setting (see Appendix A for interview script). Participants were recruited from an electronic mailing list of software professionals in California. Participants were screened prior to the interview to ensure that they qualified under this study's definition of an information worker and regularly worked from a physical office building (not a telecommuter or home office worker). The purpose of these interviews was to gather additional evidence about people's mixed reality experiences.

As shown in Table 19 below, the participant breakdown was four female / four male with a mean age of 43 and median age of 42. The participants all worked for companies whose main business was a software product or web site. The company characteristics were diverse in this sample with three participants being at very small companies (150 or fewer employees), two at large corporations (4,900 and 14,000 employees) and three at extremely large corporations (66,000 employees or more).

Participant	Age / Gender	Polychronicity	Job Title	Company Size (Employees)	Years with Company
P1	28 / F	16	Product Manager	50	2
P2	39 / M	21	Chief Architect	150	9
P3	55 / F	19	Usability Manager	4900	1
P4	49 / M	11	Technical Writer	300,000	25
P5	57 / M	16	Software Engineer	66,000	12
P6	35 / F	14	Knowledge Management Developer	15	6
P7	45 / M	17	Industrial Designer	14,000	2
P8	39 / F	17	Customer Insights Manager	160,000	5

Table 19: Summary of Interview Participants.

Data from the interviews was captured as hand-written notes. After each interview the researcher wrote a detailed account of the participant's answers in the field note format discussed previously. One limitation with the interview data is that no member checking was employed, meaning that the field notes were not reviewed by the informant to ensure agreement. However, the researcher reached theoretical saturation with the participants; where the experiences and viewpoints described by the participants converged on the same concepts which indicates credibility.

Interview Data Coding

The analysis used a grounded theory approach. The first step in coding the data was to review the field notes and interview logs to identify any data that matched or related to the constructs identified from the literature review and pilot study. These constructs are listed below and the criteria are given for which data fit.

Code	Description / Criteria
Meeting Type	What kinds of meetings do people attend? How does their technology use differ across meetings?
Group Norms for Technology Use	Both explicit and implicit rules for how people are expected to use technology in front of others.
Polychronicity	Individual preferences for multitasking behavior.
Technology Multitasking – Related to Group	Instances of technology multitasking as it pertained to the group's goals.
Technology Multitasking – Unrelated to Group	Instances of technology multitasking as it pertained to the individual's needs.
Copresence Management	Verbal and non-verbal statements/gestures indicating that the individual who is multitasking was available to communicate.
Cohesion Beliefs	How strongly the individual feels about the importance of the social dynamics of the group and the importance of the task.
Meeting Satisfaction	How satisfied individuals feel when they can technology multitask. How dissatisfied an individual feels by other people technology multitasking.
Perceived Productivity	How productive individuals believe they are when multitasking. How productive a meeting is when technology multitasking occurs.

Table 20: Data Coding for Qualitative Interview Data.

After coding the observations and notes into construct categories, the data segments were analyzed using the constant comparative technique, which is the main analytical method used in grounded theory (Auerbach & Silverstein, 2003). This technique involves taking each relevant statement from the field notes, and systematically comparing it to all the other statements from participants to identify commonalities and differences.

FACTORS CONTRIBUTING TO TECHNOLOGY MULTITASKING (THEME 1)

Meeting Type

Participants were asked to describe the different kinds of meetings that they typically attend for their job. The participants described meetings using their own terminology and structure (some participants used day of the week to frame their discussion whereas others reported their meetings based on which project it was associated). While using their own terminology, the types of meetings that participants were involved shared these basic characteristics:

- Attendance between 4 and 10 people
- Conference room location
- Leader present
- Agenda sent in advance
- An additional 2 to 3 people on teleconference
- Some people bring laptops (but rarely does everyone bring a laptop)
- Everyone has a mobile phone (typically on silent/vibrate mode)
- Two main discussion formats used:
  - Meeting leader follows agenda topics and the relevant meeting members contribute to the topic as necessary.
  - One person presents on a topic (typically using PowerPoint slides), and people are asked to contribute to the discussion following the presentation

These characteristics outlined above were developed from the interview participant's descriptions of their meetings and the observations of meetings attended by the researcher at SoftwareCorp. The table below abstracts characteristics of the different meetings described by the participants and the "X" indicates that the given meeting type was experienced by the participant.

Meeting Type Characteristics	P1	P2	P3	P4	P5	P6	P7	P8
Staff Meeting: - 30 min to 1 hour - 10 to 15 people - No laptop multitasking	X	X	X	X	X			X
Staff Meeting: - 30 min to 1 hour - 4 to 6 people - Laptop multitasking						X		
Project Meeting – Internal: - 45 min to 1 hour - 4 to 6 people - Laptop multitasking	X	X	X		X	X	X	
Project Meeting – Internal: - 45 min to 1 hour - 4 to 6 people - No laptop multitasking			X	X				X
Project Meeting – Internal Large: - 45 min to 1 hour - 20 or more people - At least 5 people dialed in - Laptop multitasking		X			X			
Project Meeting – External: - 45 min to 1 hour - 4 to 6 people - Laptop multitasking					X	X	X	

Table 21: Meeting Types by Interview Participant.

The meeting types listed in the table above are similar to two meeting types developed by Volkema & Niederman (1995): "Brainstorming/Problem Solving" and

“Round Robin”. Project meetings are problem solving meetings where people have gathered to analyze and work on specific project related issues. Staff meetings follow a round robin format, where each person takes a turn giving an update to the group.

However, the Volkema & Niederman meeting typology is not robust enough to explain technology multitasking in meetings. Their typology lacks contextual factors, specifically who else is attending the meeting and the meeting’s relevance/importance to the participant. These factors influenced participants’ decision to multitask during meetings or not. Participant 3 (P3), a usability manager for a financial products web site typically had meetings on Tuesdays and Thursdays and described herself as a “heavy multitasker”. However, when P3’s boss was present in a meeting, she modified her behavior:

> *P3: In our staff meetings, my boss leads the meeting. I’d like to be using my laptop during these meetings, but I don’t out of politeness.*

In staff meetings described by P4 (a knowledge management specialist at a small software company), laptop multitasking occurred. However, the relevance of the meeting topic changed the way she multitasked. She typically used her laptop to check e-mail or work on other tasks unrelated to the meeting. But in staff meetings which she perceived as more relevant based on the information that was shared, the laptop was only used in “good ways” such as taking notes or looking up information related to the discussion.

While participants were able to recall the different types of meetings they attended, self-reports of technology multitasking behaviors can be problematic as data. Participants may have a difficult time remembering their typical behavior (and instead recall only extremely memorable instances), additionally participants may be inclined to describe their behavior in a socially desirable manner. Another cognitive bias that can lead to skewed memories about meeting behaviors is the consistency bias (Schachter, 1999). The consistency bias purports that people will recall their past behavior in such a way that it matches their current perception of attitudes and behaviors. For the interview data, this bias could occur when participants are primed to talk about how they typically use a laptop during meetings. Once the participants have described their behaviors in a certain manner (e.g. "I never bring a laptop to meetings unless I'm giving a presentation"), any future statements that would counter this initial framing would be less likely to be revealed to the researcher.

In order to counteract this bias, the researcher tried to ground the participant's memories with real examples by having them walk-through the entire context of a meeting. This context included asking what the topic and purpose of the meeting was, how the meeting was initiated (who scheduled it, and by what means), where it was held in the office, what documents/technologies the participant brought with them, and then having them describe in detail how the meeting began (who talked first, how did people know when to participate). Furthermore, the researcher also prompted the participant to describe behaviors that were different or opposite to what the participant had previously stated as their multitasking behavior. For example, when P1 (a product manager at a web advertising firm) explained how she only used her laptop in project meetings to take notes, the researcher later followed up by asking P1 "Are there ever times in these project meetings when you would need to use your laptop for other work or personal tasks?"

An additional cognitive bias that has the potential to affect the interview data is the recency effect (Miller & Campbell, 1959); with this bias participants are more likely to recall their behavior from meetings they had that same day (of the interview) than they are to recall their past behavior. This bias was noted when both P4 and P5 would respond to the interview questions by referencing meetings that they had just attended earlier in the day. The recency effect was also noticeable when P2, P4, and P5 (who had all been with their respective companies the longest), were asked to recall what typical meetings had been like at their company 7 to 10 years ago before wireless networking and laptops were as ubiquitous. None of the participants were able to describe past meetings—this finding is not surprising given that over the years the participants had been in many different meetings and were unlikely to have given any special thoughts or placed any significance on these meetings for their own lives.

The decision tree shown in Figure 10, developed by the researcher, shows how and why the relational and contextual factors influenced an individual's decision to multitask in a meeting or not. This decision tree demonstrates how the majority of the participants who did multitask thought about their technology multitasking in meetings. While decision trees do not cover every possible scenario, they are intended to predict decision making for 85-90% of cases (Gladwin, 1989). The researcher developed this decision tree by examining the factors from the case study and interview data that influenced people's likelihood to technology multitask during a meeting.

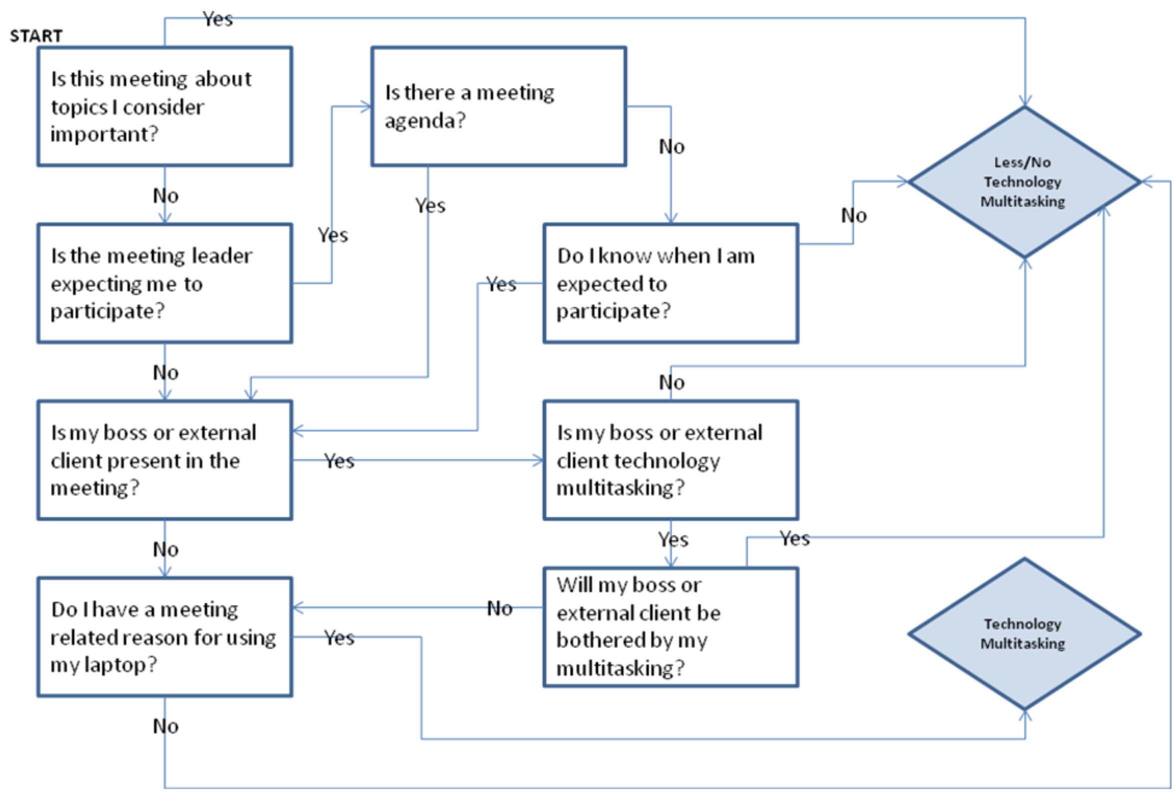

Figure 10: Decision Tree for Multitasking in Meetings.

This section presented the results that meeting type, in conjunction with who else was in attendance and how relevant the topic was to group members influenced the occurrence of technology multitasking. In the next section, polychronicity is discussed as it relates to one's propensity to multitask in meetings.

Polychronicity

Polychronicity, one's preference for multitasking, based on Lindquist & Kaufman-Scarborough's (2007) measurement was assessed using the PMTS questionnaire for each of the eight interview participants. Figure 11 below shows each score and Charles's and Sam's polychronicity levels are included too for comparison.

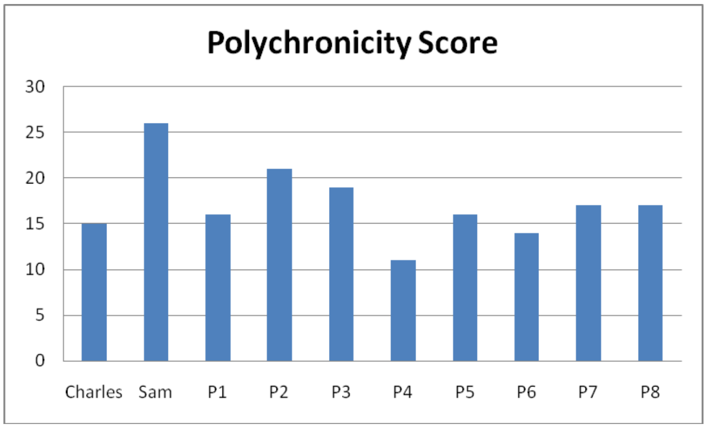

Figure 11: Polychronicity Scores for Qualitative Data.

The lowest possible polychronicity score is 5 and the highest is 35. For this data set, the minimum score is 11 and the high is 26. The mean score is 17.7 with a standard deviation of 3.97 and the median is 17. When the data is clustered into categories most participants would be labeled as "medium-low polychronicity."

Low (5-12):	1 participant
Medium-Low (13-20):	7 participants
Medium-High (21-28):	2 participants
High (29-35):	None

To assess whether polychronicity level is a trait that influences how and why participants multitasked during meetings, the interview data used from the previous section about meeting types and technology use was compared against the participant's responses to the polychronicity questionnaire. Each participant's description of their multitasking behaviors was grouped into None/Low, Medium, and High technology usage categories. In Table 22, each participant is labeled with their polychronicity score in parentheses (##). The correlation coefficient for technology use in meetings and polychronicity level was not significant: r=.469(10), $p > .05$.

Technology Use in Meetings	Characteristics of Technology Multitasking	Participant
None/Low	Rarely, if ever brings a laptop to a meeting Is bothered when others multitask during meetings	P2 (21) P4 (11) P5 (16) P8 (17)
Medium	Laptop is used in a purposeful manner that relates to the group task (e.g. taking notes) E-mail or other non-meeting tasks might be checked toward the end of the meeting or at a times when the meeting seems less relevant	Charles (15) P1 (16) P6 (19)
High	Continuously on laptop for the majority of the meeting Has a difficult time not attending to the technology Laptop is used for both meeting and non-meeting tasks	P3 (19) P7 (17) Sam (26)

Table 22: Polychronicity Score and Multitasking in Meetings.

Those in the None/Low technology use group were participants like P2 (the chief architect at a 150-person software company) and P4 (a technical writer at a 50,000-person multinational electronics and software firm) who both stated in similar words that they "never bring a laptop to a meeting unless I have a very specific purpose for it." When prompted to describe the reasons they would need a laptop, it was explained that they might need it to show a product demo or a PowerPoint presentation to the group (reasons that were based strictly on the needs of the group/meeting task). Interestingly, P2 has a high polychronicity score, yet not only did he limit his own multitasking, he reported that when he ran his meetings: "I tell everyone to put away their laptops."

P5, an engineer at a large multinational computer networking company, explained his reason for not multitasking based on a self-assessment that he could not concentrate as well when technology multitasking (though he was not bothered by other people's multitasking during meetings). And P8, a manager of website services for a national bank, focused on the etiquette issues of multitasking during meetings. She felt it was extremely rude to multitask on laptops or phones during meetings. P8 described how she did not allow her subordinates to multitask in meetings and that she always tried to lead by example by never checking her Blackberry smartphone until the meeting was over.

For the Medium technology use category, this cluster of participants multitasked during meetings but did so in ways that they felt were relevant to the meeting (such as taking notes or looking up information from online documents or web sites). However, those in the Medium usage category were not opposed to using their laptops for non-meeting (but still work related) tasks such as checking e-mail or answering instant messages. But, these participants made efforts to only multitask with non-meeting activities during meeting segments that they felt were not relevant to them and where they perceived that it would not be a detriment to the other group members.

Charles, P1, and P6 all described their Medium usage in similar ways. They all brought laptops to nearly every meeting they attended and while their laptops were always accessible, they used them only occasionally to jot down some notes or check e-mail when it would not detract from the meeting. If an instant message did come through that they noticed, it was responded to – but generally their laptops were closed for most of the meeting and it was not until the meeting was about to end (or in one case where Charles was in a 4-hour meeting and he was no longer needed as frequently) did they begin to check e-mail.

P6 even felt self-conscious about her multitasking:

> *P6: I occasionally wonder if people think I'm working on something else [unrelated to the meeting]. It makes me feel a bit self-conscious.*

In the last category for technology usage, those in the High cluster continuously used their laptops throughout the entire meeting. P7, a graphic designer at a large multinational web search engine company described how he always was on his laptop throughout meetings so that he could monitor incoming e-mails. He viewed meetings as necessary, but time consuming:

> *P7: Meetings don't need all of people's attention. There just may be a moment here or there where you're needed, but you have to be there for that moment.*

Similarly, P3 discussed how she was often double-booked for meetings, and so being on her laptop allowed her to simultaneously keep up with other work activities while attending a meeting. Despite their willingness to multitask during meetings, P3 and P7 did not view their multitasking as an ideal way to accomplish work.

> *P3: During my project meetings, I heavily multitask when the meeting's not relevant to me. I try to pay just enough attention so I know when to jump in.*

> *P7: I like to think that I have one ear open while multitasking, but I actually don't consider myself a great multitasker. I'll say something in the meeting because I want people to know that "Hey, just because I'm on a laptop doesn't mean I'm not paying attention."*

P7 explained that he tried to pay attention to the meeting and stop using his laptop if he felt it might be perceived as being rude—but that he was not always successful at meeting these two goals. Though the participants in the High usage category were attuned to the idea that their multitasking might be considered rude at times (and potentially distracting to their own abilities to participate in the meeting), they perceived their organizational culture as permissive of this multitasking and this was a natural extension of how people were expected to constantly be online and answering e-mails in their workplace.

As shown in Table 22, polychronicity score did not correlate to one's multitasking behaviors. There was no indication that those who had high polychronicity scores were more likely to multitask in meetings than those with lower scores. Based on the interview and case study data, the reasons people attribute to their multitasking behavior are based on a combination of the individual's perceived need to use the technology (they need it to take notes, they need it to check e-mail etc.) and their beliefs about the importance of meeting etiquette. In the 2x2 matrix shown in Table 23, those who felt it necessary to multitask with technology during meetings (High Need) and who simultaneously did not perceive that they were breaking any etiquette norms resulted in High Technology Usage throughout the meeting. However, should those with High Needs believe that multitasking would be perceived as unacceptable by others, they stopped multitasking or only did so during moments believed to be appropriate.

High Need to Use Laptop	High Tech Use	Low or Med Tech Use
Low Need to Use Laptop	Low, Med, or High Tech Use	Low Tech Use
	Low Etiquette Meeting	**High Etiquette Meeting**

Table 23: Likelihood to Multitask Based on Need and Meeting Etiquette.

From the interpretation of how individual's described their use of technology as compared against their polychronicity score, there is no significant correlation between the two constructs. Individuals high in polychronicity (such as Sam, P2, P3, and P6) are not similar in how they multitask during meetings. Likewise, individuals lower in polychronicity (P1, P4, P5, and P7) are equally diverse in their technology multitasking habits. The reason polychronicity may not impact multitasking behavior is likely based on the fact that regardless of one's preferences, an information worker is expected by his or her organization to be able to juggle multiple activities simultaneously. Given the small sample size of the interviews and case study data, Chapter 5 with the quantitative results will provide additional analysis on this issue.

BEHAVIORS & ATTITUDES IN MIXED REALITY (THEME 2)

Technology Multitasking

Technology multitasking during meetings is not a static state that persists; individuals used their laptop for varying lengths of time and with differing levels of engagement. From the observations at SoftwareCorp and the experiences told by the interviewees, the following diagram models the activity level of multitaskers in meetings.

In the next graph (Figure 12), the x-axis marks the differing temporal engagements people manifest with their laptops. We can distinguish use of a temporal scale between "short bursts" (30 seconds or less) and "long stretches" (2 minutes or longer). For "short bursts" individuals would use their laptop for brief moments during the meeting, and at the other extreme, "long stretches," an individual's focus of attention would be completely immersed with the technology.

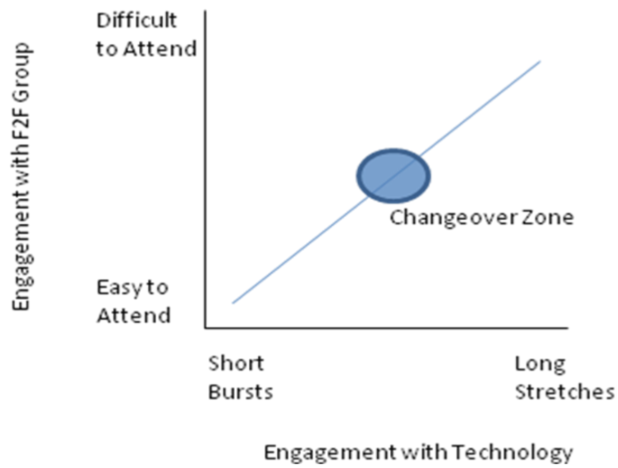

Figure 12: Level of Engagement with Technology and Group.

Based on the interviewee self-reports of behavior, all participants felt they were able to manage normal participation in the group meeting when their technology use was just short bursts. With long stretches of technology use, participants described witnessing people's "eyes becoming trapped in the technology" (P2), leading people to miss out on a question that might be posed (reported both by P6 and P7).

The mid-point area on the graph (labeled Changeover Zone), refers to a hypothetical stage of engagement, where someone is continuously using technology while actively monitoring the group discussion at hand. This level of technology multitasking might appear ideal to the user; one is able to accomplish two tasks simultaneously. However, participants felt that this level of equal engagement was not possible except for exceptional people, reported by P5, who stated that his "boss can simultaneously handle three different instant message conversations and fully participate in a face-to-face meeting at the same time." This comment is P5's perception of his boss's multitasking abilities and this study did not validate the boss's skill to engage in multiple activities without any detriment to the multiple communication acts.

While it is probable that there exist people with the cognitive capacity to manage both meeting and technology tasks well in the Changeover Zone, it seems unlikely that most people can maintain these multiple levels of engagement, especially over an extended period of time. Participants P3, P6, and P7 all described their multitasking during meetings as an act that broke down and became too cumbersome to continue due to cognitive overload between what they needed to focus on in the meeting and what they were working on with their laptops.

There appears to be a shift in technology multitasking use at the Changeover Zone, below which the user is not totally engaged, and above which the user is taxed to attend. The significance of this concept is that it impacts the analysis of cohesion beliefs, copresence management, perceived productivity, and meeting satisfaction from the conceptual model. On balance, the observational data from SoftwareCorp indicated that most people who multitasked with technology did so in short bursts (below the Changeover Zone) though observations were made at SoftwareCorp of one individual who multitasked above the Changeover Zone. The research constructs are anticipated to demonstrate differences in the following ways (see Table 24).

Research Construct	Below Changeover Zone	Above Changeover Zone
Copresence Management	Gaze will go toward speaker after using laptop Participate in meeting discussion to show that paying attention Notice incoming e-mail messages, but only respond if critical Respond to incoming instant messages	Physically move or shift body posture away from other meeting attendees Gaze completely focused on laptop screen Disengaged from meeting discussion
Cohesion Beliefs	Task relevance occurs through most of meeting Belief that occasional laptop use is acceptable to the other group members	Meeting task has no relevance Belief that it is socially acceptable to be immersed in laptop use
Meeting Satisfaction	Satisfied that time in meetings could be used to multitask	Satisfied that time in meetings could be used to multitask Non-users may negatively evaluate those users who multitask above the Changeover Zone
Perceived Productivity	Feels productive that they have kept up simultaneously with the meeting and tasks on the laptop Ability to look up information that supplements the meeting, and take electronic meeting notes	The meeting has been perceived to be unproductive, therefore the user becomes completely engaged with their technology in order to feel productive

Table 24: Anticipated Impact of Changeover Zone on Research Constructs.

Copresence Management

Copresence management was analyzed in relation to polychronicity level with the interview data. Individuals who have a greater preference for multitasking are hypothesized to exhibit increased amounts of electronic copresence. We expect those high in polychronicity to manifest increased electronic copresence with frequent use of instant messaging and e-mail. Those lower in polychronicity level are predicted to exhibit increased verbal and non-verbal signals with those in the meeting (in-room copresence).

To obtain information about copresence, the eight interviewees were asked to respond to a set of questions as follows (see interview script in Appendix A):

- How conscientious did they feel when multitasking during a meeting?
- Did the interviewee feel it was necessary to participate out loud in the meeting to demonstrate engagement with the group?
- Did they typically respond to incoming instant messages immediately?
- How compelled did the interviewee feel to keep up with e-mail messages during meetings?

This series of questions regarding copresence were difficult for the interview participants. Participants had trouble remembering what their typical meeting behavior was like. This difficulty is not surprising given that most people do not spend time remembering and reflecting on their regular work day interactions. Generally only extremely memorable (whether it be very positive or very negative) experiences are recalled.

What emerged from the interview data on copresence was a set of beliefs about categories of people being notorious for constantly multitasking and in turn, not exhibiting any in-room copresence. People who were "executives" or the "sales guys who always have their laptops" were cited by participants (P1, P2, P6, P7, and P8) as always multitasking during meetings. In essence, copresence by the executives and sales people was used not to indicate communication availability, but rather to minimize one's availability.

These participants believed that the rampant multitasking occurred because these people liked to show-off, meaning that by multitasking in the meetings they were demonstrating how important and essential they were within the company. Interestingly, P6 and P7 also described how they multitasked during meetings themselves; yet their behavior was described as necessary because of busyness or being acceptable because everyone else in the group was doing it too.

This labeling of the executives and sales people's multitasking as occurring because of character flaws (egoism) whereas one's own multitasking was due to situational factors (busyness) represents the Fundamental Attribution Error bias (Ross, 1977). People view motivations for their own behavior differently than that of others engaging in the same behavior. Others are perceived as having personality flaws for partaking in the undesirable behavior, whereas one's same behavior is due to situational factors beyond one's control.

At the other extreme of copresence were those in the high in-room copresence management category, like P8, who described how she not only silenced her Blackberry smartphone before entering meetings, but made sure that the blinking feature on the device (that would light if a new message came through) was not visible to her field of view at any point during the meeting. Had the phone's status been visible to her, she felt she would be compelled to quickly glance and see who had called or e-mailed, and she did not want that temptation.

In Table 25 below, three levels of copresence are described (None/Low, Medium and High), and participants' perceptions of their copresence behaviors are categorized.

Copresence Management	**Characteristics of Copresence**	**Participant (Polychronicity)**
None/Low	Always on their laptop Potentially considered rude by others Oblivious to whether participation is needed or necessary	"Notorious multitaskers" described by P1, P2, P6, P7, and P8
Medium	Try to be mindful of who else is present in the meetings and whether it is considered rude or not for a given situation Will respond to new IMs and e-mails when it does not seem to interfere with the meeting too much If everyone in the group is multitasking, they will likely do so too	Charles (15) Sam (26) P1 (16) P3 (19) P6 (19) P7 (17)
High	It's always perceived as being rude or obnoxious to be on the laptop Avoid using technology in meeting for multitasking	P2 (21) P4 (11) P5 (16) P8 (17)

Table 25: Levels of Copresence Management.

Overall, participants believed themselves to be conscientiousness toward other individuals in group meetings. None of the interview participants felt that they exhibited negative copresence (purposefully disengaging from the meeting) though they described that this behavior occurred with notorious multitaskers. While the description of Sam's continuous multitasking behavior presented earlier in this chapter might suggest he belongs in the "None/Low" category, his own perception and that of his team members leads him to be placed in the "Medium" grouping.

Half of the interviewees made purposeful efforts at avoiding technology use during meetings so that they were able to engage fully with the meeting at hand. The other half of participants fell into a middle range of behaviors where they felt balanced between monitoring their electronic copresence (via e-mail and instant messaging) while remaining diligent toward the in-room communication needs.

Cohesion Beliefs & Technology Multitasking

Individuals who perceive a particular meeting to be highly relevant and who also care about the social bonds within their team are expected to feel increased cohesion with those in the meeting. These individuals would find it desirable to demonstrate that they are engaged with the meeting at-hand, and therefore would act in ways to show that they are paying attention and available for participation in the meeting.

The case study and interview data regarding cohesion and technology multitasking indicate that social bonds amongst work colleagues of the same level are not as strong an indicator for multitasking behavior as compared to task relevance. The only social factors that people discussed as affecting their behavior were based on power relationships and unfamiliarity. P1, P3, and P6 described how they were less likely to multitask when senior management or external clients were present in the meeting.

Participants did not want to offend other meeting attendees with multitasking when it was considered outside of the norm of acceptability for the group. For example, when meeting with a client, P6 specifically changed her behavior by not multitasking in front of them. However, P6 was much more likely to multitask when working with her regular teammates with whom she was highly familiar. This finding suggests that increased social cohesion based on closeness may lead to more multitasking (which is contradictory to the finding originally anticipated by the researcher). Essentially, there is greater comfort level to multitask in front of those we are already familiar with. Cohesion as defined on the social dimension does not impact one's multitasking behavior, but task relevance does as P1 explained:

> *P1: I'll always bring my laptop to meetings, but if I am really interested in what's being talked about in the meeting, of course I'm not going to be sitting there checking my e-mail.*

Behavior in mixed reality meetings was examined in this section by analyzing how the interview participants described the style of their multitasking, if and how they managed copresence and how their cohesion beliefs impacted use. Two main styles of technology multitasking were identified, short bursts and long stretches; with short bursts being the most typical way of multitasking. All participants believed that they maintained copresence with their collocated team even when they multitasked. Cohesion beliefs analyzed from the social dimension did not influence technology multitasking though the task factor of cohesion did impact use (the greater the task relevance, the less likely multitasking occurred).

OUTCOMES FROM MIXED REALITY (THEME 3)

Meeting Satisfaction

Similar to the findings with Charles and Sam, participants stated that they typically had not given much thought to whether they enjoyed meetings more or less due to technology multitasking. Three participants (P3, P5, and P7) described technology use in meetings as "the way things are now" and the fact that some people seemed caught up in multitasking to be a "sin we all take part in" (P7).

This finding suggests that people are habituated into their everyday routines and are not reflecting on their attitudes toward this topic and how it impacts their work. While participants were not able to express any satisfaction increase from multitasking, negative moments from multitasking did stand out in the recollections.

> *P4: I was just in a meeting this morning and I was annoyed by the woman next to me using her laptop. My eyes kept glancing over to her screen and it was very distracting.*

> *P1: My company instituted a $1 fine for multitasking in meetings. This one guy completely ignored the rule and would ceremoniously pay the fine before every meeting and use his laptop.*

In P4's comments, someone else's laptop use detracts from his meeting satisfaction because he feels compelled to keep glancing over. However, no other participants described being similarly distracted or bothered by other people's technology multitasking. As P5 explained, "Our [15 person start-up] doesn't have any rules about laptop use in meetings. And honestly, I don't think anyone has ever brought this up as an issue."

In P1's comments she relays her perceptions of how someone in her company felt about not being allowed to use technology. When the researcher asked P1 how the $1 fine had become instituted, she used the phrase "general consensus" amongst group members to describe how the rule was initiated. However, as seen by the latter half of her quote where one person makes a show of paying the fine each time in defiance, $1 was not a severe enough (or seriously taken) penalty. In a study on monetary penalties and behavior change by Gneezy & Rustichini (2000), parents having to pay a $3 fine when picking up their child late from daycare was not a substantial enough amount to change behavior. In fact this monetary penalty reduced any feelings of guilt parents felt about coming late thereby leading to increases in the undesirable behavior (of arriving late).

Overall, meeting satisfaction in mixed reality was not a concept that participants related to except in negative instances. P7's experience below sums up the general attitude of the participants: that multitasking was necessary and not particularly problematic.

> *P7: Multitasking in the end is okay. There may be a degradation in the richness of information that is shared, but there are enough checks and balances in the workplace that nothing is going to get ruined because of it.*

Similar to the findings presented in the case study, interview participants were not cognizant of how their own technology multitasking increased or decreased their satisfaction with meetings. Despite the perceived normalcy of mixed reality (as also recounted by Charles and Sam), other people's technology multitasking behaviors did not go unnoticed, especially for participants like P4, who found it disruptive to his concentration.

Perceived Productivity

How did individuals perceive their own productivity when technology multitasking in meetings? What were people's opinions toward the productivity of the meeting overall when technology multitaskers were present? Perceived productivity is a subjective construct based on an individual's beliefs about their behaviors. These impressions are important because they represent how valuable the behavior is to the multitasker. If one does not feel productive when multitasking, there is minimal incentive to continue. On the other hand, if multitasking is valued as a means of accomplishing increased amounts of work, we would expect people to articulate this notion.

Productivity was discussed by the participants based on how they multitasked during meetings and whether technology multitasking was a distraction. In Table 26, half of the interview participants described how laptops were productivity tools during meetings when the topic was boring or no longer relevant to their needs.

As P6 explained:

> *P6: I have this one meeting where we all go around the table and ask questions to the engineering lead. It takes forever to get to my turn, and typically other people's questions aren't relevant to me, so if I didn't have my laptop with me I'd be incredibly bored.*

While the laptop was also used to supplement the meeting (taking notes and looking up information), this was discussed by fewer participants and was not perceived as meaningful to their productivity compared to when laptops were used in the boring/less relevant meeting segments. A third category of participants (P4 and P5) felt that their productivity was negatively impacted by technology multitasking. P4 explained how other people's multitasking was distracting to him in meetings and he was not able to concentrate as well. P5, on the other hand, was not bothered by other people's technology multitasking, but thought he was a terrible multitasker and therefore never brought a laptop to meetings. As shown in Table 26 below, overall participants held positive views toward technology multitasking; it was viewed as a productivity tool when the meeting was no longer relevant, and as an enhancement to the meeting task through meeting notes and increased access to information.

Meeting Productivity	**Description of Productivity**	**Participant (Polychronicity)**
Productive for Other Work	Laptop is used when a meeting is boring or irrelevant	P1 (16) P3 (19) P6 (19) P7 (17)
Productive as Supplement of Meeting	Laptop is used to look up information or take notes	P1 (16) P8 (17)
Other People's Use Distracting	Productivity is diminished by technology use	P4 (11) P5 (16)

Table 26: Perceived Productivity in Mixed Reality Meetings.

In summary, productivity in meetings due to technology multitasking was based primarily on the idea that the laptop provided useful access to other work during meeting segments that were of less import to the participant. While laptops were used to supplement meeting tasks and were a productivity tool in that regards too, this reason was not as highly cited by participants.

SUMMARY OF QUALITATIVE DATA

In Table 27, a summary of the research findings is presented. Overall, mixed reality meetings were viewed by the interview participants as a typical and expected behavior in their workplaces. Due to the nature of information work, which relies heavily on computing technologies (especially e-mail and instant messaging), most participants felt compelled to constantly access their laptops to keep up with their online communication needs. On the whole, participants who chose to multitask in meetings believed that they did so reasonably well; meaning that they felt they could pay just enough attention to the meeting discussion while using their laptop (P1, P3, P6, and P7).

However, there were conflicting attitudes about technology multitasking. Three participants (P2, P4, and P8) all perceived multitasking in meetings as disruptive to themselves and the larger team, and they specifically avoided the act and informed employees below them to do the same (P4 and P8). But P5 maintained that he was unperturbed by other's laptop use in meetings, even though he also never multitasked.

Research Construct	Qualitative Research Outcome
Theme 1: Factors Contributing to Technology Multitasking *Meeting Type* *Polychronicity*	Meeting type impacted likelihood to multitask (internal project meetings more prone to mixed reality than staff meetings). Polychronicity level did not predict likelihood to multitask. However, SoftwareCorp data with Charles and Sam suggest that polychronicity may influence whether one multitasks with unrelated work during meetings.
Theme 2: Behaviors and Attitudes in Mixed Reality *Technology Multitasking* *Copresence Management* *Cohesion Beliefs*	Technology multitasking mainly occurs in short bursts. Most people do not believe they multitask well in meetings, but they feel it is necessary to do so when the meeting is irrelevant or because they are busy and need to keep up with other work. Most participants believed that they managed in-room copresence well (participating as they needed to in the meeting). Electronic copresence was always maintained if using a laptop; e-mail and instant messaging were the primary reasons to multitask during meeting. Social liking amongst group members did not directly impact how or whether people multitasked during meetings. However, task relevance did predict technology multitasking; the more relevant the meeting task, the less likely multitasking occurred.
Theme 3: Outcomes From Mixed Reality *Meeting Satisfaction* *Perceived Productivity*	Participants were no more or less satisfied in meetings due to technology multitasking, though some could recall negative situations when it had impacted a meeting. Overall, participants believed they were more productive with technology multitasking, using it in ways that both supported the meeting and their other work tasks. Only two participants felt strongly that technology multitasking was a detriment to the meeting.

Table 27: Summary of Research Findings from Qualitative Phase.

This diversity in behaviors and attitudes is not surprising given the range of people's experiences with the topic. The implication of this phase of research suggests that organizational norms and individual attitudes are in an evolving stage in the workplace on the topic of mixed reality. Participants (Charles and P1) cited times when the company tried to mandate how technology could be used in meetings, yet this rule proved difficult to enforce or was eventually forgotten as more individuals began to multitask again. This breakdown in norms suggests that there may be a tension between the culture of information work (one of being "always-on" and accessible virtually) and traditional views of face-to-face group work (everyone needs to participate equally to be a part of the team). A balance between these competing values has yet to be achieved and is reflected in the multitude of behavior and attitudes analyzed in this data.

CONCLUSION

This chapter presented the qualitative results from the case study fieldwork at SoftwareCorp and the eight one-on-one focused interviews with information workers from either other corporations. The research focus of this work was developed from the themes identified originally in the literature review and the initial pilot study with office workers (Chapter 3). The role of meeting type and polychronicity were explored as they influenced the likelihood to multitask in meetings. Cohesion and copresence were discussed as components leading to behavioral changes with multitasking, and outcomes toward satisfaction and productivity in mixed reality meetings were examined.

The data gathered from SoftwareCorp and the eight interviewees was complementary. The observations of behavior in SoftwareCorp meetings were supported by the interviewee descriptions of their own experiences. These real world observations and reflections of mixed reality meetings provide a background for this topic which are validated in the next chapter using a survey methodology.

CHAPTER 5: *QUANTITATIVE RESULTS (PHASE 2)*

This chapter presents the results from Phase 2, the survey based examination and extension of the qualitative studies of mixed reality reported in Phase 1 (Chapter 4). The primary goal of the survey is to obtain a broader, statistically validated understanding of participant experiences and attitudes towards mixed reality. Two pilot surveys (n=46 and n=42) were conducted at the outset to validate the research constructs and survey questionnaire. Following these pilots, surveys were administered to the California employees of SoftwareCorp (n=156) and to an online panel of individuals from the general public who self-identified as information workers (n=110). Throughout this chapter, the survey with SoftwareCorp employees is identified as Wave 1 and the survey with the online panel is Wave 2.

The complete data set (Pilots 1 & 2 and Waves 1 & 2) yields a validation of the theoretical model constructs and support for 7 of the 10 research hypotheses. An additional contribution of this survey was the development of statistically validated research scales to measure *cohesion beliefs, copresence management*, and *perceived productivity.* An examination of these survey results in relation to the qualitative analysis is reported in Chapter 6.

PILOT SURVEY INSTRUMENTATION

The development and validation of the survey questionnaire is described through two different iterations (Pilot 1 & Pilot 2). In Pilot 1, the researcher used a sample of convenience to obtain responses from people within her personal network (n=46). To reduce the bias of having similar respondents, Pilot 2 used a sample of participants obtained from an online panel of technology workers from across the United States provided by the Syracuse Study Response Project (n=42). These two sample sets provided sufficient feedback for the revision of the questionnaire and identification of general trends in the data. The pilot data was also used to identify the statistical techniques employed in the analysis of survey Waves 1 & 2.

Questionnaire Development

The survey was created by developing questionnaire items that addressed the research objectives. The questions were derived in two main ways: 1) reviewing and incorporating existing scales that were related to the research constructs and 2) creating questions based on the findings from the qualitative research phase reported in the previous chapter. The findings from the qualitative phase were essential for providing real-world behavioral and attitudinal survey questions about mixed reality.

Few validated scales existed that were appropriate for use in their entirety in this research; these scales did not reflect the context of the organizational meeting environment and/or did not include multitasking or technology use as part of the scale. However, one scale that was used in its original format was the Polychronic-Monochronic Tendency Scale (Lindquist & Kaufman-Scarborough, 2007) which served as the measurement for *polychronicity*. Of the different polychronicity scales reviewed in Chapter 2, PMTS was selected for this research because of its high validity. Lindquist & Kaufman-Scarborough have refined the PMTS scale through multiple different research studies and validated that it has strong internal consistency, discriminant validity and nomological validity.

To develop the scales for *cohesion beliefs, copresence management, perceived productivity*, and *meeting satisfaction* in mixed reality, the researcher was guided by the following related scales as shown in Table 28. The researcher incorporated relevant phrasing and conceptual ideas from the scales reviewed, and then wrote additional questionnaire statements based on the research goals.

For *cohesion beliefs*, the researcher relied on the theoretical framework from the Group Environment Questionnaire (Carron & Brawley, 2000) described in Chapter 2. In the GEQ, cohesion is split across two dimensions: social and task cohesion. Since the GEQ was primarily developed for sports teams, the researcher was also influenced by Chin, Salisbury, Pearson, & Stollak (1999) with their Perceived Cohesion Scale which validated social cohesion based on feelings of belonging and morale in an experiment testing decision-making with an electronic meeting system.

The *copresence* scale by Nowak & Biocca (2003) was developed for a dyadic virtual reality environment where copresence is a measure of feelings of closeness and relationship maintenance. In the copresence scale developed for this research, the focus is changed from measuring feelings to assessing behaviors in mixed reality meetings, both with those in the same room (in-room copresence) and electronic communication partners from e-mail and instant messaging (electronic copresence).

In DeVreede, Niederman, & Paarlberg's (2001) scale for *meeting satisfaction*, people's perceptions of a specific meeting instance are measured. For this research, meeting satisfaction is abstracted to measure feelings about mixed reality meetings in general (not just one instance) and incorporates relevant phrasing about laptop use in meetings too.

For *perceived productivity*, the researcher employed concepts from Staples, Hulland, & Higgins's (1999) measurement scale on productivity of remote workers. In this research, the productivity scale was reduced to four questions that focused on the respondent's beliefs about how productive laptop use was for them during meetings.

Related Scale	Scale Used in Mixed Reality Research
Group Environment Questionnaire (Carron & Brawley, 2000) - Questionnaire items in Table 4 on page 35. **Perceived Cohesion Scale (Chin et al., 1999)** - I feel that I belong to this group. - I am happy to be part of this group. - I see myself as part of this group. - This group is one of the best anywhere. - I feel that I am a member of this group. - I am content to be part of this group.	**Cohesion Beliefs** - Team members make an effort to participate in meeting discussions. - Team members share the workload evenly. - Our team meetings are coordinated and organized well. - It is important for me to be liked by other members of the team. - Overall, I feel like I am an essential part of my team.
Copresence in Virtual Environments Scale (Nowak & Biocca, 2003) *Self-Reported Copresence* - I did not want a deeper relationship with my interaction partner. - I wanted to maintain a sense of distance between us. - I was unwilling to share personal information with my interaction partner. - I wanted to make the conversation more intimate. - I tried to create a sense of closeness between us. - I was interested in talking to my interaction partner.	**Copresence Management** *In-Room Copresence* - I try and make occasional eye contact with whoever is speaking. - I make a point to participate in the meeting discussion. - I nod my head slightly when I hear something that I agree with. - I lower or close my laptop screen when I'm done multitasking. *Electronic Copresence* - I notice all new incoming e-mail messages when in a meeting. - I write and respond to e-mail messages during a meeting - I send instant messages to other people in the meeting who have laptops. - I send instant messages to work colleagues who are not in the meeting. - I won't initiate instant message conversations, but I will reply to incoming IMs. - I find it essential to be online throughout the meeting so that I can communicate with others who are not in the room.

Meeting Satisfaction (DeVreede, Niederman, & Paarlberg, 2001)	Meeting Satisfaction
- The results of today's meeting (did not - did) meet my personal needs. - The value of the meeting's outcomes justifies our efforts. (disagree- agree) - How satisfied were you with the work process we used today? (dissatisfied - satisfied) - The outcomes of today's meeting were (unsatisfactory- satisfactory).	- I am more satisfied in meetings when I can use my laptop. - It bothers me when other people in a meeting use laptops. - I feel self-conscious when I multitask with a laptop in a meeting. - I dislike it when other people in the meeting glance at what I'm doing on my laptop.
Overall Perceived Productivity & Remote Work Effectiveness (Staples, Hulland, & Higgins, 1999) *Overall Productivity* - I believe I am an effective employee. - Among my work group, I would rate my performance in the top quarter. - I am happy with the quality of my work output. I work very efficiently. - I am a highly productive employee. - My manager believes I am an efficient worker. *Remote Work Effectiveness* - Working remotely is not a productive way to work. - It is difficult to do the job being remotely managed. - Working remotely is an efficient way to work. - Working remotely is an effective way to work. -	**Perceived Productivity** - Having a laptop in a meeting allows me to be more productive. - Having a laptop in a meeting leads me to be more efficient at my job. - Having a laptop in a meeting makes me more effective at my job. - Having a laptop in a meeting allows me to produce better quality work.

Table 28: Related Scales to Research Constructs.

Utilizing the qualitative results, the researcher also wrote questionnaire statements that reflected the attitudes and experiences of the case study and interview participants. For example, "[When I'm in a meeting] I lower my laptop screen a little to show that I am paying attention." was drawn from the results with the interviewees. Approximately 50 different statements were written initially, and after reviewing these in relation to the research goals, the statements deemed most reflective of the research constructs were kept. The statements were checked to ensure that they were concise, not double-barreled (asking two separate ideas in a single question), and relevant to the constructs.

Face validity of the questionnaire was reviewed by the researcher to ensure that each questionnaire item could be linked to the research hypotheses and to the construct it represented. Face validity was also reviewed by one Ph.D.- and one Master's-level researcher who both have experience being information workers and conducting social science research projects. The reviewers were given an instruction sheet that listed each research construct with a definition. The reviewers were asked to associate each of the questionnaire items to the different constructs.

Content validity was checked by reviewing the qualitative research results to ensure that the breadth of experiences reported in the qualitative analysis were reflected in the survey questions. The researcher compared the raw interview data (quotes and field note segments) to each of the construct items to ensure that all of the major issues discussed by the interviewees were encapsulated by the questionnaire.

As required by the University of Texas Institutional Review Board, introductory statements of consent were added to the questionnaire. In order to prime participants to begin thinking about their work meetings, a set of questions addressing the frequency and type of work meetings was asked first. Demographic questions about age, gender, job role, and managerial status were placed at the end of the questionnaire. Following Babbie's (1995) survey ordering guidelines, the questions aimed to achieve a balance between easy and difficult questions. The most challenging questions were placed on the second and third web page of the questionnaire after the participant had gained familiarity with the survey format with a set of easy questions on the first page.

Design Validity

To ensure that the web-based survey was in an optimal format for completing online, the researcher followed the web-design guidelines for surveys as prescribed by Schonlau, Fricker, Elliott, & Fricker, Jr. (2002). The following guidelines were utilized to ensure optimal viewing: only listing three or fewer questions for each web screen, showing the percentage progress complete, avoiding any graphics or extraneous information, and using color in matrix format questions to increase readability. The survey questionnaire was hosted online by a third-party survey hosting tool called Surveymonkey (http://www.surveymonkey.com).

Sampling Validity in the Pilot Studies

In the first pilot survey (Pilot 1), the researcher used a sample of convenience from her personal network of friends employed in industry. Additionally, snowball sampling was used to increase the number of participants. Snowball sampling (Goodman, 1961) is defined as the recruitment of additional participants by current participants, where each participant is asked to refer other people in their network into the research (and the newly recruited participants are then asked to do the same). One major concern with this form of sampling is the bias that can occur because participants tend to be similar to the people they recruit. Therefore, the potential of the survey results to be skewed in a particular direction is high with snowball sampling.

In order to obtain a broader sample compared to the first pilot, the second pilot survey used an online panel provided by the Syracuse Study Response Project (http://studyresponse.syr.edu/studyresponse). This university-based organization provides academic researchers with a panel of survey participants based on the sampling criteria desired. For this second pilot study, the researcher requested that the panelists work in

Telecommunications or Technology fields (these fields were pre-defined by the Study Response Project database). These two job fields were selected because they best represented the definition of people who are information workers. Each respondent in the second pilot survey was paid $5 for participation.

While the participants in the second pilot survey have the potential to be more diverse in attitudes and opinions since they are strangers from across the United States, issues of validity and bias are still a concern with online panels. These individuals have self-selected to be a part of web-based survey panels; this fact makes the respondents less representative of the target population. This issue is not unique to online survey participants, conventional paper or telephone-based recruiting methods have a similar issue of self-selection in that only people amenable to completing the survey do so—these individuals may have a particular interest in the topic which again could alter the results toward one direction.

One of the methods to adjust for self-selection of online participants is propensity scoring (Schonlau et al., 2002). With propensity scoring, demographic characteristics such as socio-economic class and educational achievement are used to re-weight the distribution of scores to more accurately reflect the population of interest. In this research, propensity scoring was not used since it was not possible to identify how the online panel differed from the population of information workers in general (insufficient demographic characteristics were collected to attempt propensity scoring). However, in the implementation of the survey in Wave 2, the respondent demographics are compared against a similar sample used by Pew Internet Research (2008) to ensure representativeness.

Construct Reliability

Table 29 shows the Cronbach's alpha coefficients for each of the constructs measured in the two pilot surveys. The associated survey questionnaire items (e.g. Q16a, Q16b…) for each of the constructs is available in Appendix B. Cronbach's alpha is a measure of how internally consistent each of the questionnaire items is for a unidimensional construct. A unidimensional construct is one in which the associated questionnaire items are all explained by the same latent variable (Falissard, 1999). The larger the coefficient alpha, the more one can attribute the variance in responses to general and group factors, and not from the questionnaire items (Cortina, 1993). An alpha value of .70 or greater is the standard recognized by most researchers for an acceptable construct (Nunnally, 1978).

However, a large alpha value does not ensure unidimensionality; for example, alpha values can be increased by adding additional items to the scale, therefore factor analytic techniques must be used to identify that each questionnaire item is associated with the intended construct. In the pilot surveys, it was not possible to use factor analysis because of the small sample size; however factor analysis was completed with the data from Waves 1 and 2.

Research Construct	Cronbach's alpha Pilot 1	Cronbach's alpha Pilot 2
Polychronicity	**.914** (Q16a, Q16b, Q16c, Q16d, Q16e)	**.960** (Q4a, Q4b, Q4c, Q4d, Q4e)
Technology Use Norms	**.730** (Q12a, Q12b, Q12c, q12d)	-.674 (Q7a, Q7brev)
Cohesion Beliefs	.300 (Q14a, Q14brev, Q14c, Q14d, Q14erev, Q14f)	.681 (Q5a, Q5b, Q5crev, Q5d, Q5e)
Copresence Management	.562 (Q13a, Q13b, Q13c, Q13drev)	**.876** (Q8c, Q8d, Q9a)
Meeting Satisfaction	.564 (Q15a, Q15crev, Q15erev)	.580 (Q10a, Q10brev, Q10crev)
Perceived Productivity	.358 (Q15b, Q15drev)	**.911** (Q10d, Q10e, Q10f, Q10g)

Table 29: Cronbach's alpha Scores - Pilot 1 & Pilot 2.

The first pilot questionnaire achieved a .70 or higher coefficient alpha on the constructs of *polychronicity* and *technology use norms*. In Pilot 2, the questions were modified as described in the next section which improved the reliability scores of *cohesion, copresence management*, and *perceived productivity.*

Re-Design of Questions Based on Pilot 1 Results

This section describes the changes to the questionnaire based on the results from Pilot 1.

Survey Length:

In anticipation of needing a questionnaire that would take no longer than five minutes to complete for Wave 1, the length of the questionnaire was evaluated. As part of the agreement negotiated with SoftwareCorp for access to their employees, the company leadership placed a limitation on the number of survey questions.

In Pilot 1, the mean survey completion time for the 46 respondents was 8 minutes 40 seconds with a standard deviation of 3 minutes and 38 seconds. The six fastest respondents finished the survey in 4-5 minutes and the three slowest respondents completed the survey in 15-20 minutes. For Pilot 2, the following question types were removed based on their length and usefulness for the analysis:

Questions about the frequency of multitasking in a given meeting type

Questions about how easy it was to check e-mail messages at work

Questions about how "tech-savvy" the workplace is perceived.

Since this survey took place chronologically after the researcher's qualitative fieldwork (described in Chapter 4), the researcher was confident that the removal of these questions would not impact the main research goals since this data was known from the fieldwork already. After removing these questions, the median time to complete Pilot 2 was 4 minutes 11 seconds which excludes the time of 2 participants who took 27 and 44 minutes to complete the survey, respectively. The extreme time duration that these 2 participants manifest suggests they left their computers or were interrupted for some time before deciding to finish the survey. Fifteen respondents completed this survey in approximately 2 minutes or shorter time.

Polychronicity: No change in the questions used.

Technology Use Norms: Pilot 1 had a .730 coefficient alpha value for technology use norms. However, upon review of the questions associated with this construct, it was determined by the researcher that the questions were not evaluating whether a team had instilled norms for technology use amongst its members (see Table 30). Instead, Q12a, Q12b, and Q12c were reflecting issues of group size and power structures. Two new questions (Q7a and Q7b) were used for the second pilot instead, but they did not produce a valid coefficient alpha (-.673). The negative alpha value indicates a problem with the data or that the two items do not measure the same construct. Since it was not possible to determine the exact problem at this stage, Q7a and Q7b were kept the same for Wave 1.

Pilot 1 Tech Use Norms Questions	Q12a. The more people there are in the meeting, the less I use my laptop. Q12b. When my boss or supervisor is in the meeting, I use my laptop less. Q12c. When upper/senior management is in a meeting, I use my laptop less. Q12d. If no one else is using a laptop in the meeting, I won't use one either.
Pilot 2 Tech Use Norms Questions	Q7a. Everyone on my project team knows when it is appropriate to multitask with a laptop. Q7b. I wish my team had more explicit rules about how laptops should be used during meetings.

Table 30: Pilot Items for *Technology Use Norms.*

Cohesion Beliefs: The coefficient alpha value for cohesion was improved in the second pilot by removing the questions about importance of participation (Q14d), spending time with the group (Q14e), and speaking freely in meetings (Q14f); see Table 31. Question Q14f was removed because the Cronbach's alpha analysis showed that removing this question increased the reliability of the other questions to .497. Question Q14e was removed because it did not appear to represent the value of social cohesion meaningfully (i.e., it did not specify a context for why one would or would not spend time with other team members). Finally, Question Q14d was changed to question individual participation in contrast to group participation (Q5a) in order to gauge how well the individual felt the entire team participated overall, not just the relevance of his or her own contributions.

Pilot 1 Cohesion Questions	Q14a. It is important for me to be liked by other team members. Q14b. The project meetings I attend are generally disorganized. Q14c. I can trust my teammates to do their fair share of the work. Q14d. My participation in project meetings is critical to the team's success. Q14e. I prefer not to spend time with members in the group. Q14f. We can say anything in the meeting without having to worry.
Pilot 2 Cohesion Questions	Q5a. Team members make an effort to participate in meeting discussions. Q5b. Team members share the workload evenly. Q5c. My team does not coordinate our meeting activities very well. Q5d. It is important for me to be liked by other members of the team. Q5e. Overall, I feel like I am an essential part of my team.

Table 31: Pilot Items for *Cohesion Beliefs.*

The disorganization question (Q14b) was re-worded to emphasize meeting coordination (Q5c). This decision was made based on recognition that the concept of coordination better represented the arrangement of work overall between group members. However, this re-wording did not prove to be a successful change. In fact, removal of question Q5c "My team does not coordinate our meeting activities very well." increased the coefficient alpha from .470 to .681. It is possible that wording difficulties caused people to misread the question.

Copresence Management: The questions about copresence were changed in their entirety between Pilot 1 and 2 (see Table 32). In the first pilot, Q13a was removed based on reviewing the qualitative interview data and determining that changing instant message status was not a typical behavior. For Q13b, Q13c, and Q13d, these questions were changed from asking about copresence with those in the meeting, to copresence with electronic communication partners. This change was made based on the qualitative data which showed that participants had better recall about how they used technology in meetings compared to their memories about subtle non-verbal behaviors (in-room copresence). However, in Wave 2, a set of questions about in-room copresence was added back into the survey in a final attempt to validate the two types of copresence, electronic and in-room. The construct reliability tests used in Wave 2 found both types of copresence to have high reliability and validity.

Pilot 1 Copresence Questions	Q13a. Before going into a meeting, I change my instant message status to let people know that I'm busy. Q13b. While using my laptop in a meeting, I make sure to nod my head a little to show that I am paying attention. Q13c. When using a laptop in a meeting, I purposefully try and participate in the meeting to show that I am paying attention. Q13d. I usually leave my laptop entirely open for the entire meeting.
Pilot 2 Copresence Questions	Q8c. I respond to incoming instant messages while in a meeting. Q8d. I use my laptop during meetings to maintain communication with others outside of the meeting. Q9a. I tend to use my laptop for non-meeting related tasks (e.g. checking e-mail / working on other projects).

Table 32: Pilot Items for *Copresence Management.*

Meeting Satisfaction: The meeting satisfaction questions were modified between Pilot 1 and 2 but the coefficient alpha remained approximately the same (from .564 to .580); see Table 33. The question about laptop use being bothersome (Q15c) was changed to identify disruption as a cause leading to dissatisfaction. And, the question about being stressed because of multitasking (Q15e) was changed to specify feelings of self-consciousness when using a laptop in meetings (Q10c). In the factor analysis for Waves 1 and 2 it was determined that meeting satisfaction was not a unidimensional construct, therefore satisfaction was removed in these two waves which limits the results of evaluation of meeting satisfaction to rely strictly on the qualitative data.

Pilot 1 Meeting Satisfaction Questions	Q15a. I am more satisfied in meetings when I can use my laptop. Q15c. It bothers me when other people in a meeting use laptops. Q15e. I am stressed out in meetings because of multitasking.
Pilot 2 Meeting Satisfaction Questions	Q10a. I am more satisfied in meetings when I can use my laptop. Q10b. I find it disruptive when other people use laptops in a meeting. Q10c. I feel self-conscious when I multitask with a laptop in a meeting.

Table 33: Pilot Items for *Meeting Satisfaction.*

Perceived Productivity: The perceived productivity construct was significantly improved in the second pilot study from a coefficient alpha .358 in Pilot 1 to .911 in Pilot 2 (see Table 34). Using Haynes's (2007) review of organizational productivity, the questions were changed to identify efficiency (Q10d) and effectiveness (Q10e) as important facets of productivity.

Pilot 1 Perceived Productivity Questions	Q15b. Having a laptop in a meeting makes me more productive. Q15d. Meetings are less productive because people are distracted by technology.
Pilot 2 Perceived Productivity Questions	Q10d. Having a laptop in a meeting leads me to be more efficient at my job. Q10e. Having a laptop in a meeting makes me more effective at my job. Q10f. Having a laptop in a meeting allows me to be more productive. Q10g. Having a laptop in a meeting allows me to produce better quality work.

Table 34: Pilot Items for *Perceived Productivity.*

PILOT SURVEY RESULTS

Due to the small n (46 in Pilot 1 and 42 in Pilot 2), the analysis of the pilots is limited to examination of general patterns in the data. The primary purpose for the pilot studies was to design and validate the survey questionnaire. The secondary purpose was to identify the appropriate statistical procedures to employ in the survey waves at

SoftwareCorp and with the online panel of information workers. In the following results sections, these general trends in the pilot data are briefly reviewed and a discussion of statistical analysis techniques is presented.

Respondent Characteristics

The demographic characteristics of the respondents are shown for both pilot studies in Table 35. As can be seen, the samples were similar across most demographic characteristics, except for gender, company type, and frequency of participants who multitask with a laptop in meetings. Pilot 1 was predominantly more male, from larger corporations, and had an increased number of people who multitasked with technology during meetings.

The other main difference between the two pilot samples is in job role. In Pilot 1, 29 out of 46 respondents self-described their roles as being related to a computing industry (e.g. Webmaster, Engineer, Programmer, etc.), and the other 17 respondents had occupations such as Accountant, Attorney, Public Relations Manager, or an unspecific role such as Consultant or Manager. Pilot 2, as mentioned previously, had participants only from the Telecommunications and Technology fields. Pilot 2 is more representative of the information worker population that is anticipated to participate in the final two survey waves. However, the differences noted with the Pilot 1 characteristics do not detract from using the data to test construct reliability and statistical techniques.

Characteristics	Pilot 1 (n=46)	Pilot 2 (n=42)
Gender		
Female	14 (30%)	22 (52%)
Male	32 (70%)	20 (48%)
Age Range		
18 to 24 years old	0 (0%)	2 (5%)
25 to 34 years old	16 (35%)	11 (26%)
35 to 44 years old	15 (33%)	17 (40%)
45 to 54 years old	12 (26%)	9 (21%)
55 to 64 years old	3 (6%)	3 (7%)
Manager Status		
Manager	21 (45%)	18 (43%)
Non-Manager	25 (55%)	24 (57%)
Company Type		
Large Corporation	30 (65%)	17 (40%)
Medium Corporation	9 (20%)	14 (33%)
Small Business	5 (11%)	8 (19%)
Other	2 (4)	3 (7%)
Length at Company		
2 years or less	11 (24%)	14 (33%)
3 to 7 years	16 (35%)	8 (19%)
8 to 15 years	19 (41%)	13 (31%)
16 years or more	0 (0%)	7 (17%)
Length in Job Role		
2 years or less	19 (41%)	14 (33%)
3 to 7 years	25 (54%)	17 (40%)
8 to 15 years	2 (4%)	9 (21%)
16 years or more	0 (0%)	2 (5%)
Typically Multitask with a Laptop in Meetings?		
Yes	33 (72%)	20 (48%)
No	13 (28%)	22 (52%)

Table 35: Demographic Characteristics - Pilot 1 & Pilot 2.

Statistical Techniques Overview

The survey constructs use ordinal level data in the form of 7-point Likert scales (Strongly Disagree to Strongly Agree). Since ordinal-level data is not continuous, it is argued to be inappropriate to use parametric tests such as t-tests, analysis of variance and regression analysis (Gardner & Martin, 2007). With ordinal data, the one-unit difference between "1 and 2" on the Likert scale cannot be assumed to be the same unit difference as between "3 and 4" on the same scale.

However, there is a tendency for many researchers to use parametric tests on ordinal data. Harwell & Gatti (2001) suggest that researchers can re-scale ordinal variables into interval variables using algorithmic transformations devised from item-response theory. Dowling & Midgley (2006) compare survey data results in ordinal format subjected to MANOVA and this same data after it was transformed into interval data with MANOVA and reported no significant difference in the results. Dowling & Midgley (along with others e.g. Labovitz, 1970) argue that the statistical power of MANOVA and similar techniques is robust enough to handle the unknown unit differences in ordinal data.

There are continuing theoretical and methodological arguments among measurement scholars for using either non-parametric or parametric tests on ordinal data (e.g. Anderson, 1961; Marcus-Roberts & Roberts, 1987; Knapp, 1990). However, this research will rely on non-parametric statistical procedures. The non-parametric tests are given primary standing in this research because they are more conservative and therefore less prone to Type 1 errors. For reference, commonly used non-parametric tests and parametric equivalents are listed below.

Non-Parametric	**Parametric**
Wilcoxon	Paired t-test
Mann-Whitney	Independent t-test
Kruskal-Wallis	One-way ANOVA
Friedman test	Two-way ANOVA
Spearman's rho	Pearson r

General Data Analysis of Pilot Surveys

The two sets of pilot data were analyzed to identify any patterns or trends in the data. The mean, standard deviation, and score range for all of the major constructs (*polychronicity, cohesion beliefs, copresence management, perceived productivity,* and *meeting satisfaction)* were calculated and bar charts were made of the responses. Due to the small sample size, the summary data were difficult to interpret unambiguously. Since the future analysis of Waves 1 and 2 will be based on the correlations between the constructs, a surface examination of the relationships was completed using SPSS statistical software. The statistical findings described below were used to ensure that improvements had been made to the questionnaire between the two pilot studies but are not considered to be statistically valid for the final analysis due to the small sample size.

As shown in Table 36, with Pilot 1 only one hypothesis (Proposition 1) resulted in a significant finding. Proposition 1 was not tested in Wave 2 because this set of questions was removed to shorten the survey length as discussed on page 166. Participants in Pilot 1 rated how frequently they multitasked with a laptop for five different meeting types, and the chi-square analysis (using a Friedman test) was significant. After the questionnaire changes made to the constructs, Pilot 2 results identified Hypotheses 4 and 7 as significant and the researcher felt comfortable proceeding with using the Pilot 2 questionnaire in Wave 1 at SoftwareCorp.

Research Hypothesis	**Pilot 1**	**Pilot 2**
P1: The context of the meeting (the meeting type) will influence the decision to multitask with technology.	**$\chi^2(4, N = 46) = 85.61, p < .001$**	——
H1: Individuals high in polychronicity will multitask with technology more than those low in polychronicity.	$\chi^2(3, N = 46) = 2.71, p > .05$	$\chi^2(2, N = 42) = .305, p > .05$
H4a: Individuals high in polychronicity will manifest greater electronic copresence.	Spearman's *rho* value = .086 with $p > .05$	Spearman's *rho* value = .350 with $p > .05$
H8: Individuals high in polychronicity will perceive meetings as more productive when technology multitasking occurs.	Spearman's *rho* value = .198 with $p > .05$	**Spearman's *rho* value = .567 with $p < .01$**
H5: Individuals who feel cohesive with their immediate team will have greater in-room copresence.	Spearman's *rho* value = -.254 with $p > .05$	Spearman's *rho* value = .219 with $p > .05$
H9: Individuals who feel cohesive with their immediate team will perceive less productivity with technology multitasking.	Spearman's *rho* value = .247 with $p > .05$	**Spearman's *rho* value = .552 with $p < .05$**

Table 36: Statistical Correlations - Pilot 1 & Pilot 2.

Summary of Methodological Lessons from Pilot Studies

Pilot 1 and Pilot 2 provided two opportunities for the researcher to test the reliability of the survey constructs, the length of time to complete the questionnaire, and identify validity issues. Based on these pilot studies, all of the questionnaire items for the research constructs were improved by the second pilot. The survey length was shortened to meet the requirements of SoftwareCorp and face and content validity issues were addressed. Even with a small n, by Pilot 2, three of the constructs resulted in significant effects.

The next section describes the implementation of the survey at SoftwareCorp (Wave 1). Following a discussion of the Wave 1 results, additional changes were made to the questionnaire and a final validation of the theoretical model and research hypotheses is discussed with the results from Wave 2.

SOFTWARECORP SURVEY (WAVE 1)

The research design and survey implementation at SoftwareCorp is described in the following sections. The goal of this survey was to collect additional evidence for how people multitask with technology at SoftwareCorp in order to supplement the qualitative case study data.

Participants

The SoftwareCorp participants were solicited via an e-mail message from the SoftwareCorp manager who was assisting the researcher with this project. This e-mail explained the general focus of the survey on the topic of laptop multitasking and emphasized that participation was voluntary and anonymous (shown in Appendix E). The solicitation e-mail was sent two separate times during June 2009. In exchange for participation, respondents were allowed to request a copy of the executive report prepared for SoftwareCorp that discussed these survey results.

The e-mail message was sent to approximately 800 employees in the Southern California region of SoftwareCorp 179 responses were collected, but thirteen were removed due to missing answers. The final participant count was 156 employees who were primarily product managers, engineers, and quality assurance specialists. Due to privacy issues emphasized by SoftwareCorp Human Resources, data about gender and age of the participants were not obtained.

Construct Reliability

The internal consistency of each research construct was tested by calculating Cronbach's coefficient alpha in SPSS (Scale > Reliability Analysis command). Cronbach's alpha measures how well each of the questionnaire items represents the overarching construct. For the previous discussion about Cronbach's alpha, please refer to the pilot studies section on page 165.

As shown in the Table 37 below, *polychronicity, meeting satisfaction,* and *perceived productivity* exceed the .70 alpha level, but *electronic copresence*, *technology use norms,* and *cohesion beliefs* do not. Since *cohesion beliefs* is approaching the .70 level, for the purposes of the current results it will be included as acceptable. While *electronic copresence* and *technology use norms* will also be discussed in this set of results, the findings will be considered exploratory and need additional confirmation from Wave 2 with the online panel of respondents. The questionnaire items referred to under each construct (e.g. Q5a) are shown in Appendix C.

Research Construct	Cronbach's alpha
Polychronicity (Q5a, Q5b, Q5c, Q5d, Q5e)	.934
Electronic Copresence (Q9c, Q9d, Q10a)	.588
Cohesion Beliefs (Q6a, Q6b, Q6d, Q6e)	.653
Meeting Satisfaction (Q11a, Q11brev, Q11crev)	.766
Perceived Productivity (Q11d, Q11e, Q11f, Q11g)	.870
Technology Use Norms (Q8a, Q8brev)	.581

Table 37: Initial Cronbach's alpha Values - SoftwareCorp (Wave 1).

Validation of Constructs with Factor Analysis

To validate convergent and discriminant validity of the research constructs, exploratory factor analysis using the principal components model was employed to identify the load values of each of the questionnaire items against the construct (which ensures unidimensionality). For convergent validity, the optimal finding would be that items measuring the same construct are more highly correlated with each other than they are with items from other constructs. And, for discriminant validity, we would expect unrelated questionnaire items to have minimal correlation with each other. The Dimension Reduction > Factor command was used in SPSS to complete this analysis in the following 4-step process.

Step 1: KMO & Bartlett's Test

Before proceeding with the factor analysis, the data must meet a Kaiser-Meyer-Olkin (KMO) value of .60 or greater and the Bartlett's Test for Sphericity needs to be significant ($p < .05$). The KMO value represents the proportion of common variance across the items and Bartlett's Test determines if the items are interrelated. This survey data met the KMO criterion with a value of .678 and the Bartlett's Test is significant with $p < .001$.

Step 2: Communalities

The communalities of each of the items are examined which is a measure of the proportion of variance accounted for within each item by the factors. Ideal communality measurements are .60 or larger. In this questionnaire, five items had low communality as shown in Table 38 below.

Questionnaire Item	Communality
Overall, I feel like an essential part of my team.	.462
When using a laptop in the meeting, I make a point to participate to show that I am paying attention.	.528
I respond to incoming instant messages while in a meeting.	.516
I tend to use my laptop for non-meeting related tasks (e.g. checking e-mail/working on other projects).	.508
I tend to use my laptop for meeting related tasks (e.g. taking notes/looking up relevant information).	.598

Table 38: Low Communality Values - SoftwareCorp (Wave 1).

Items with low communality are considered poor fits for the factor model, and may need to be dropped from the analysis. In fact, after completing the factor analysis, it was determined that “Overall, I feel like an essential part of my team.” was a poor item that did not contribute to the model and it was dropped from the *cohesion beliefs* scale.

Step 3: Eigenvalues & Variance Explained

The factor analysis calculated that six (6) components explained 62% of the variance in the model (see Table 39). An eigenvalue must be 1.0 or greater to be kept in the model and is an indicator of the amount of variance explained by the component (the larger the eigenvalue, the larger the variance explained).

Component	Eigenvalue	% Variance
1	5.987	22.17%
2	3.493	12.94%
3	2.209	8.18%
4	1.989	7.37%
5	1.725	6.39%
6	1.348	4.99%

Table 39: Questionnaire Eigenvalues - SoftwareCorp (Wave 1).

Step 4: Varimax Rotated Factor Matrix

The components identified in the factor analysis were further investigated by analyzing the varimax rotated matrix. The components identified in Step 3 are labeled with their associated construct in Table 40 which also shows the load values for each of the associated questionnaire items (e.g. Question Q11d’s load value is .891). Discriminant validity was assured for all but one of the items. Item “I find it disruptive when others use a laptop in meetings.” correlated -.580 with Component 1 and .545 with Component 3. This item was originally intended for the *meeting satisfaction* construct.

Additional evaluation of the items for *meeting satisfaction* in the varimax matrix showed this construct converging with items for *perceived productivity.*

What emerged from the factor analysis is that *meeting satisfaction* conflated with *perceived productivity* and the single item questions intended to reflect satisfaction were invalid. Additionally, a new construct emerged, labeled *self-efficacy of technology use*, which indicates an individual's level of comfort with multitasking; both from an ability standpoint (e.g., "It is easy for me to follow the meeting discussion while simultaneously using my laptop.") and from a social standpoint (e.g., "I feel self-conscious when I multitask with a laptop in a meeting.")

Component	Construct	Items
1	Perceived Productivity	Q11d - .891 Q11e - .787 Q11f - .801 Q11g - .661 Q11a - .712
2	Polychronicity	Q5a - .867 Q5b - .710 Q5c - .826 Q5d - .830 Q5e - .849
3	Self-Efficacy of Technology Use	Q9a - .841 Q10d - -.544 Q11c - .690
4	Cohesion Beliefs	Q6a - .763 Q6b - .792 Q6d - .744 Q6e - .437
5	Electronic Copresence	Q9b - -.574 Q9c - .705 Q9d - .700 Q10a - .639
6	Technology Use Norms	Q8a -.836 Q8b - .748

Table 40: Factor Analysis Constructs - SoftwareCorp (Wave 1).

While it is disconcerting that the *meeting satisfaction* construct was not properly identified as a stand-alone construct, the Cronbach's coefficient alpha value for *perceived* *productivity* increased from .870 to .886 when the item "I am more satisfied in meetings when I can use my laptop." was added to the construct. From a theoretical standpoint, productivity and satisfaction should be two separate entities; people can attend meetings that are very productive but highly unsatisfactory and vice versa. One reason why productivity and satisfaction were not distinguishable in this survey may be because the questions were not reflecting a specific meeting instance, rather the questionnaire asked people to think about their meetings in general.

In summary, exploratory factor analysis using the principal components model verified the convergent and discriminant validity of the known constructs (*polychronicity, perceived productivity, cohesion beliefs, electronic copresence, technology use norms*), and helped create a new construct *self-efficacy of technology use* (Cronbach's alpha = .756). The analysis also determined that *meeting satisfaction* was not a construct in this questionnaire, so it was dropped from the analysis. The final constructs and associated item questions are summarized in Table 41 below.

Research Construct	**Cronbach's alpha**
Polychronicity (Q5a, Q5b, Q5c, Q5d, Q5e)	.934
Electronic Copresence (Q9c, Q9d, Q10a)	.588
Cohesion Beliefs (Q6a, Q6b, Q6d,)	.690
Perceived Productivity (Q11a, Q11d, Q11e, Q11f, Q11g)	.886
Technology Use Norms (Q8a, Q8brev)	.581
Self-Efficacy of Technology Use (Q9a, Q10drev, Q11c)	.756

Table 41: Final Cronbach's alpha Values - SoftwareCorp (Wave 1).

DATA OVERVIEW & RE-CODING

Likert scale data was collected from 156 respondents and the response values were loaded into SPSS. For the questionnaire items asking about how the respondent used a laptop during meetings, only participants who answered that they typically multitasked with a laptop were shown this set of questions. Therefore, as seen in Table 42, the constructs of *copresence*, *perceived productivity,* and *self-efficacy* have only 77 responses (which are from the 77 people who said they multitasked with laptops). With this purposeful data reduction, there is no impact on the resulting analysis since the associated hypotheses rely on assessing how technology multitaskers behave in meetings.

Construct	n	Mean Score	SD	Range
Polychronicity	156	23.72	7.75	5 – 35
Cohesion Beliefs	156	5.00	.928	1 – 7
Tech Use Norms	156	4.04	1.42	1 – 7
Electronic Copresence	77	4.90	1.11	2 – 7
Perceived Productivity	77	5.14	1.02	1 – 7
Self-Efficacy of Technology Use	77	3.84	1.29	1 – 7

Table 42: Construct Summary - SoftwareCorp (Wave 1).

In order to perform the statistical analyses that follow, the following standard transformations were performed on the data (see Table 43).

Research Construct	Data Transformation
Polychronicity	Summed Q5a-Q5e to create Polychronicity score ranging from 5 to 35.
Polychronicity	Grouped polychronicity scores into 4 levels, Low (5 to 12), Medium-Low (13 to 18), Medium-High (19 to 28), and High (29 to 35).
Electronic Copresence	Calculated mean score based on Q9c, Q9d and Q10a.
Cohesion Beliefs	Calculated mean score based on Q6a, Q6b and Q6d.
Cohesion Beliefs	Summed Q6a, Q6b, Q6d and grouped into 3 levels, Low (3 to 11), Medium (12 to 16) and High (17 to 21).
Perceived Productivity	Calculated mean score based on Q11a, Q11d-Q11g.
Technology Use Norms	Calculated mean score based on Q8a, and Q8b (reverse scored).
Self-Efficacy of Technology Use	Calculated mean score based on Q9a, Q10d (reverse scored), and Q11c.

Table 43: Data Transformations - SoftwareCorp (Wave 1).

ORGANIZATION OF SOFTWARECORP – WAVE 1 SURVEY RESULTS

The following sections present the data analysis results from Wave 1. The results are organized into four themes (these same themes were used in the discussion of qualitative results in Chapter 4). In this chapter, each of the research themes is now linked to the associated research hypotheses (see Table 44).

1) Factors Contributing to Technology Multitasking (H1, H2, H3)
2) Behaviors in Mixed Reality Meetings (H4a, H5)
3) Attitudes Toward Mixed Reality Behavior (H6, H7)
4) Mixed Reality Meeting Outcomes (H8, H9)

Research Hypotheses
P1: The context of the meeting (the meeting type) will influence the decision to multitask with technology.
H1: Individuals high in polychronicity will multitask with technology more than those low in polychronicity.
H2: Individuals who are highly cohesive with their teams will multitask less.
H3: Managers will multitask with technology more than non-managers.
H4a: Individuals high in polychronicity will manifest greater electronic copresence.
H4b: Individuals low in polychronicity will manifest greater in-room copresence.
H5: Individuals who feel cohesive with their immediate team will have greater in-room copresence.
H6: Individuals who feel cohesive with their team will believe that others on their team multitask appropriately.
H7: Individuals high in polychronicity will have higher self-efficacy with technology multitasking.
H8: Individuals high in polychronicity will perceive meetings as more productive when technology multitasking occurs.
H9: Individuals who feel cohesive with their immediate team will perceive less productivity with technology multitasking.

Table 44: Research Hypotheses.

These themes encapsulate the entire experience of mixed reality beginning with the individual and group drivers that lead to laptop multitasking, followed by an examination of the behaviors and attitudes in these meeting contexts and ending with an evaluation of its impact on organizational meetings. These same themes and hypotheses will be used for the discussion of Wave 2 results, and the chapter will conclude with an overall summary of the outcomes.

FACTORS CONTRIBUTING TO TECHNOLOGY MULTITASKING (THEME 1)

This section addresses the survey results by examining the constructs hypothesized to impact the likelihood to multitask in meetings. Based on the literature review analysis (see Chapter 2), polychronicity was predicted to correlate with an increased likelihood to multitask with technology in meetings. Given that individuals who are higher in polychronicity already prefer to multitask in their life in general, we would expect them to do the same in meetings.

Beliefs about cohesion in the team were also hypothesized to impact the likelihood to multitask. However, high cohesion beliefs (people who feel strongly bonded to the team), are projected to negatively correlate with the likelihood to multitask. The stronger one feels cohesion with their team, the less one will multitask because the needs of the team meeting should be more important than other work.

For the third hypothesis, managers are anticipated to multitask with technology more so than non-managers. Managers attend more meetings and spend more time communicating and coordinating work tasks (Romano, Jr. & Nunamaker, Jr., 2001), and therefore are expected to utilize time spent in meetings for technology multitasking.

H1: Individuals high in polychronicity will multitask with technology more than those low in polychronicity.

H2: Individuals who feel highly cohesive with their teams will multitask less.

H3: Managers will multitask with technology more than non-managers.

Polychronicity & Likelihood to Multitask (H1)

Does polychronicity level determine the likelihood that one multitasks in a meeting with a laptop? Polychronicity scores can range from a low of 5 to a high of 35. For the 156 participants at SoftwareCorp, 108 had a polychronicity score of 21 or higher with a mean score of 23.72 (SD = 7.75). Figure 13 shows the distribution of scores which skew to the left. This distribution of scores shows a tendency for SoftwareCorp employees to have a strong preference for multitasking in their lives.

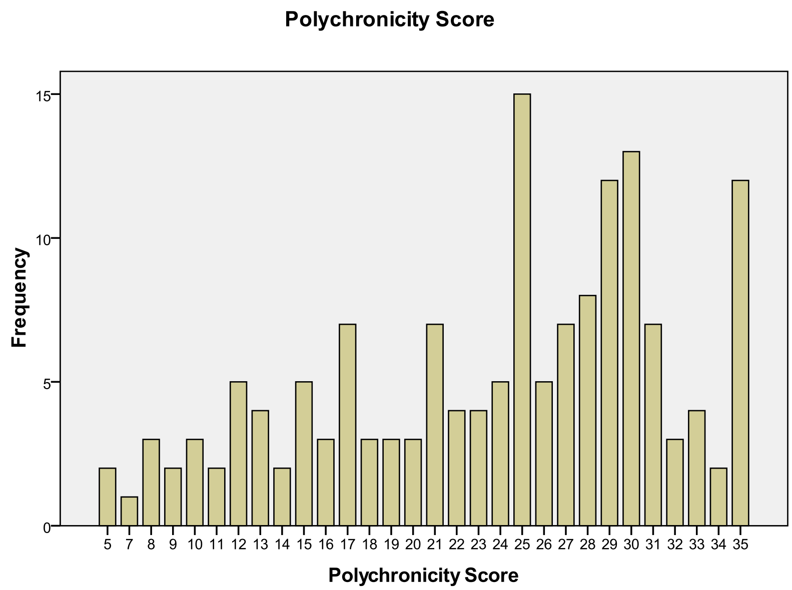

Figure 13: Polychronicity Score Chart - SoftwareCorp (Wave 1).

The scores were grouped into four nearly equal category levels: Low (5 to 12), Medium-Low (13 to 20), Medium-High (21 to 28), and High (29 to 35). The researcher split the polychronicity scores into four categories in order to maintain the most variability in the scores while having a sufficient number of responses in each category to run a meaningful chi-square analysis. Table 45 shows that those in the Low category are unlikely to use laptops during meetings, whereas those in the High category are likely to multitask with technology. For those individuals in the Medium range (Medium-Low & Medium-High) polychronicity groupings, they are nearly equally divided between those who use laptops in meetings and those who do not.

		Polychronicity Level				Total
		5 to 12	13 to 20	21 to 28	29 to 35	
Q7. Do you typically use a laptop computer during project meetings?	Yes	3	13	26	35	77
	No	15	17	29	18	79
Total		18	30	55	53	156

Table 45: Cross-tab for Polychronicity Level & Laptop Use - SoftwareCorp

A chi-square test for significance of polychronicity level and laptop use in meetings found a significant result: $\chi^2(3, N = 156) = 14.13, p < .01$. However, the chi-square test does not determine which of the polychronicity levels is contributing to the significance. A post-hoc test was completed using a contingency table with standardized residual values calculated based on the expected responses to laptop use subtracted from the observed responses. The standardized residual values for each of the polychronicity levels are listed in Table 46 below.

			Polychronicity Level				Total
			5 to 12	13 to 20	21 to 28	29 to 35	
Q7. Do you typically use a laptop computer during project meetings?	Yes	Count	3	13	26	35	77
		Expected Count	8.9	14.8	27.1	26.2	77.0
		Residual	-5.9	-1.8	-1.1	8.8	
		Std. Residual	-2.0	-.5	-.2	1.7	
	No	Count	15	17	29	18	79
		Expected Count	9.1	15.2	27.9	26.8	79.0
		Residual	5.9	1.8	1.1	-8.8	
		Std. Residual	1.9	.5	.2	-1.7	
Total		Count	18	30	55	53	156
		Expected Count	18.0	30.0	55.0	53.0	156.0

Table 46: Std. Residuals for Polychronicity & Laptop Use - SoftwareCorp.

The standardized residual cells of interest in the contingency table are those with an absolute value that meets or exceeds a chosen critical value. Under a 95% confidence limit, the standardized residuals would need to be 1.96 or larger for significance, and with a 90% confidence limit, the significant residuals would be 1.64 or larger. When significance is achieved, the observed frequency count is statistically different from the expected frequency (Sheskin, 2003).

As can be seen in the contingency table (Table 46), those Low in polychronicity who used laptops in meetings met the 95% confidence limit (2.0 std. residual > 1.96 critical value), and those in the Low category who did not use laptops met the 90% confidence limit (1.9 std. residual > 1.64). Respondents in the High grouping of polychronicity exceeded the 1.64 critical value in both the "yes" and "no" conditions for laptop use in meetings.

To ensure that the significant findings about polychronicity score and likelihood to multitask were not a result of the four category split, an additional analysis was run grouping the scores into 3 clusters: Low (5 to 14), Medium (15 to 25), and High (26 to 35). A significant result was maintained: $\chi^2(2, N = 156) = 7.65, p < .05$. Therefore, it is at the extreme levels of polychronicity in which laptop use in meetings is likely to occur (High polychronicity) or not (Low polychronicity). For those individuals in the middle ranges with polychronicity scores between 13 and 28, it is not predictable whether one multitasks in meetings with laptops. This finding suggests that for those in the middle range other factors are greater contributors to the likelihood of using a laptop in meetings.

Cohesion & Likelihood to Multitask (H2)

Cohesion was summed on Q6a, Q6b, and Q6d and the distribution of the scores is shown in Figure 14. The mean score is 14.99, SD=2.78. The graph skews to the left slightly, indicating that in general more people feel cohesive with their teams. The conceptual model predicted that people who are more cohesive with their teams would be less likely to multitask.

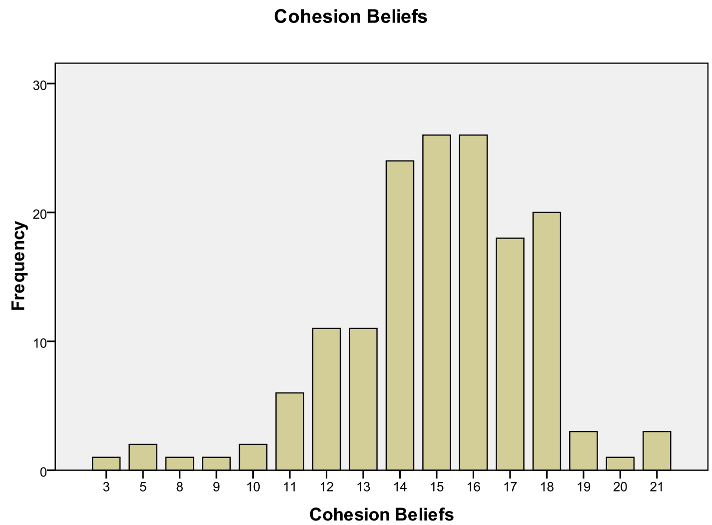

Figure 14: Cohesion Score Bar Chart - SoftwareCorp (Wave 1).

Similar to the analysis completed with polychronicity, the cohesion scores were grouped into three categories: Low (3 to 11), Medium (12 to 16), and High (17 to 21). The responses for typical laptop use in meetings organized by cohesion level are shown in Table 47 below.

		Cohesion Level (3 Groups)			
		Low 3 to 11	Medium 12 to 16	High 17 to 21	Total
Q7. Do you typically use a laptop computer during project meetings?	Yes	6	54	17	77
	No	7	44	28	79
Total		13	98	45	156

Table 47: Cross-tab for Cohesion Level & Laptop Use - SoftwareCorp.

A chi-square test for significance of cohesion score and laptop use in meetings found a non-significant result: $\chi^2(2, N = 156) = 3.76, p > .05$. To ensure that the three clusters used to group the cohesion scores were not impacting the results, additional groupings were tested as shown in Table 48. The rationale for the additional analyses was that the initial results might be skewed since 114 of the 156 participants had a score between 14 and 18 for cohesion beliefs. In the first row in Table 48 below, the cohesion scores were clustered based on the natural breaks in Figure 14, in the second row only those scoring 11 or higher on cohesion were analyzed and in the third row all scores were grouped into 4 clusters. However, none of these groupings affected the chi-square analysis results, all were non-significant.

Cohesion Beliefs Groupings	Chi-Square Results
Natural Breaks in Histogram: Low (3 to 13) Medium (14 to 16) High (17 to 21)	$\chi^2(2, N = 156) = 4.01, p > .05$
Removed Scores Below 11: Low (11 to 14) Medium (15 to 17) High (18 to 21)	$\chi^2(2, N = 149) = 3.40, p > .05$
Four Clusters: Low (3 to 7) Medium (8 to 12) High (13 to 16) Very High (17 to 21)	$\chi^2(3, N = 156) = 4.82, p > .05$

Table 48: Cohesion Beliefs & Laptop Use Analyses - SoftwareCorp.

Therefore, it is not possible to conclude with this survey wave that people's feelings of cohesion toward their team significantly impacted their decision to multitask during meetings.

Managerial Status & Likelihood to Multitask (H3)

People who have managerial responsibilities must help coordinate the work of others and communicate amongst their immediate team and with others in the organization. Since managers have increased communication needs, Hypothesis 3 predicts that managers will be more likely to multitask in meetings than non-managers. A chi-square test for significance of manager status and response to whether one typically multitasks with a laptop produced a significant result: $\chi^2(1, N = 156) = 23.71, p < .001$.

Of the 52 managers, 40 of them (77%) multitask in meetings. Of the 104 non-managers who answered this same question, only 37 of them (35%) indicated multitasking in meetings. The standard residuals in Table 49 shows all of them exceed the 95% confidence level being larger than 1.96.

			Q16. Do you supervise the work of other employees on a day-to-day basis?		
			Yes	No	Total
Q7. Do you typically use a laptop computer during project meetings?	Yes	Count	40	37	77
		Expected Count	25.7	51.3	77.0
		Residual	14.3	-14.3	
		Std. Residual	2.8	-2.0	
	No	Count	12	67	79
		Expected Count	26.3	52.7	79.0
		Residual	-14.3	14.3	
		Std. Residual	-2.8	2.0	
Total		Count	52	104	156
		Expected Count	52.0	104.0	156.0

Table 49: Cross-tab for Managerial Status & Laptop Use - SoftwareCorp.

Summary of Factors Impacting Likelihood to Multitask

For Theme 1, polychronicity and managerial status were found to significantly correlate with the likelihood that one used a laptop during meetings. With polychronicity, it was at the extreme ends of the scale (either High or Low) that predicted technology multitasking. Those individuals in the middle range of polychronicity levels (scores between 13 and 28) were equally likely to use their laptop in meetings or not.

Cohesion beliefs were hypothesized to lower the likelihood that one would multitask in meeting, but no significant relationship was found. Since the Cronbach's coefficient alpha value for cohesion beliefs is .690 (lower than the standard .70 acceptability mark), the scale items for cohesion will be modified in Wave 2 in order to re-assess the relationship between cohesion and likelihood to multitask.

BEHAVIOR IN MIXED REALITY MEETINGS (THEME 2)

How did SoftwareCorp employees change behaviorally when using their laptops in meetings? This section explores how copresence management was impacted in mixed reality. Hypothesis 4a predicts that individuals with a propensity for multitasking (high polychronicity) will use their laptops to maintain communication with colleagues outside of the meeting through e-mail and instant messaging (electronic copresence). High polychronicity individuals are theorized to find it efficient to utilize their laptops to maintain communication with work colleagues outside of the meeting.

In Hypothesis 5, however, in-room copresence is expected to increase for those individuals who feel cohesive with the others in the meeting. In-room copresence management is the verbal and non-verbal signals an individual uses to indicate that they are engaged in the group meeting (such as nods of the head, eye contact and verbal participation).

H4a: Individuals high in polychronicity will manifest greater electronic copresence.

H5: Individuals who feel cohesive with their immediate team will have greater in-room copresence.

Polychronicity & Electronic Copresence (H4a)

People who prefer to multitask (high polychronicity) are anticipated to exhibit greater levels of electronic copresence. Individuals who are comfortable multitasking are likely to maintain e-mail and instant messaging communication when multitasking. A non-significant result was found indicating that polychronicity and electronic copresence have no relationship (Spearman's *rho* value = .019 with $p > .05$).

Cohesion Beliefs & In-room Copresence (H5)

A non-significant result was found indicating that cohesion and in-room copresence have no relationship (Spearman's *rho* value = .080 with $p > .05$). Based on not finding any support for hypotheses H4a and H5, the copresence management construct will be revised in Wave 2.

ATTITUDES TOWARD ONE'S OWN MULTITASKING (THEME 3)

How did SoftwareCorp employees perceive their technology multitasking? This section examines the attitudes of employees toward multitasking in terms of technology use norms (H6) and self-efficacy of technology use (H7). Hypothesis 6 predicts that individuals who feel strongly cohesive with their team will believe that others in their team who technology multitask do so appropriately. The rationale for Hypothesis 6 is that people will feel less perturbed by technology multitasking when it occurs from team members with whom they feel cohesive.

Self-efficacy with technology multitasking was a newly derived construct from the results of the factor analysis. In Hypothesis 7, people who are high in polychronicity level, are anticipated to feel confident with their ability to technology multitask during meetings.

H6: Individuals who have high cohesion beliefs will perceive appropriate multitasking from others.

H7: Individuals high in polychronicity will have higher self-efficacy about their technology multitasking.

Cohesion Beliefs & Technology Use Norms (H6)

A significant result was found indicating that cohesion beliefs and technology use norms have a moderate relationship (Spearman's *rho* value = .203 with $p < .05$). As predicted, individuals who are highly cohesive with their teams will perceive others on their team as multitasking appropriately and that the team has understood norms for this behavior. However, the construct for *technology use norms* achieved a low coefficient alpha score (.581) so this result should be considered exploratory.

Polychronicity & Self-Efficacy of Technology Use (H7)

Self-efficacy of technology use was a newly developed construct based on the factor analysis results. It consists of three questions that assess the individual's comfort level with multitasking based on perceived ability and social appropriateness. The questionnaire items for self-efficacy are as follows:

Q9a. If my boss or upper management is also in the meeting, I multitask on my laptop less.

Q10d. It is easy for me to follow the meeting discussion while simultaneously using my laptop.

Q11c. I feel self-conscious when I multitask with a laptop in a meeting.

Theoretically we would expect that individuals high in polychronicity would have high self-efficacy in regards to their ability to multitask during meetings. A significant result was found indicating that polychronicity level and self-efficacy have a moderate linear relationship (Spearman's *rho* value = -.301 with $p < .01$). The correlation has a negative value since the questions were not reverse scored.

MIXED REALITY MEETING OUTCOMES (THEME 4)

Are mixed reality meetings more productive than those without technology multitasking? Hypotheses 8 and 9 examined perceived productivity in meetings based on polychronicity level and cohesion beliefs.

> *H8: Individuals high in polychronicity will perceive meetings as more productive when technology multitasking occurs.*

> *H9: Individuals who feel cohesive with their team will perceive lower productivity when technology multitasking occurs.*

Polychronicity & Perceived Productivity (H8)

Do individuals higher in polychronicity believe that they are more productive in meetings when they multitask with laptops? The summed polychronicity scores (ranging from 5 to 35) were analyzed using Spearman's *rho* with the perceived productivity score that was calculated as the sum of Q11a, Q11d, Q11e, Q11f, and Q11g.

A significant result was found indicating that polychronicity score and productivity have a moderate linear relationship (Spearman's *rho* value = .316 with $p < .01$). The direction of this relationship was verified using a scatterplot (see Figure 15).

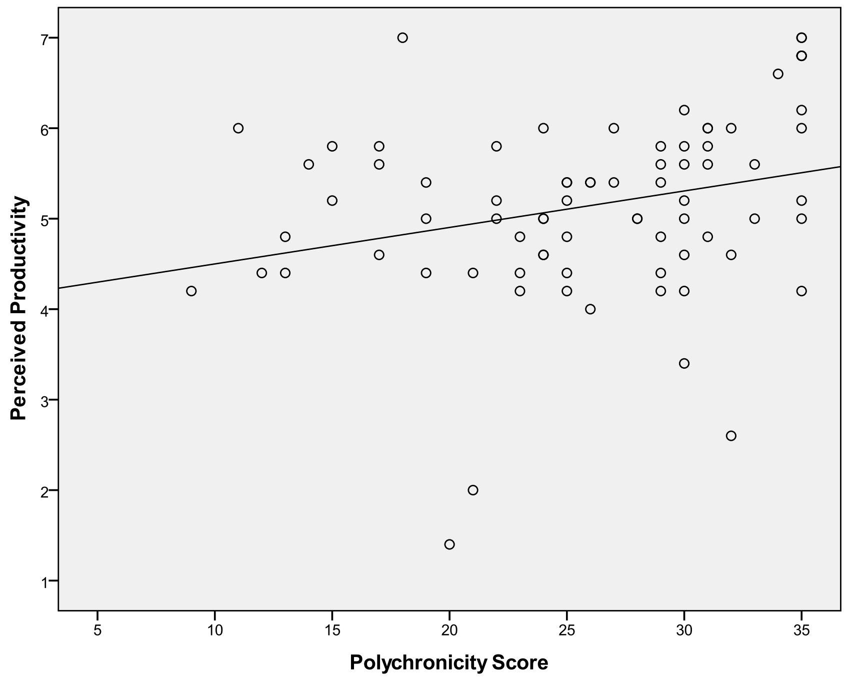

Figure 15: Polychronicity & Productivity Scatterplot - SoftwareCorp.

Cohesion Beliefs & Perceived Productivity (H9)

Hypothesis 9 predicted that highly cohesive teams would not perceive technology multitasking as productive. However, a non-significant result was found indicating that cohesion and perceived productivity have no significant relationship (Spearman's *rho* value = .021 with $p > .05$).

SUMMARY OF FINDINGS (SOFTWARECORP)

SoftwareCorp employees exhibited a diverse range of behaviors and attitudes toward laptop multitasking in meetings. Approximately half of the employees surveyed actively multitasked with laptops during meetings. Those with higher polychronicity scores who multitasked believed that they were more productive when doing so (H8), and likewise, the higher one's polychronicity score the more confidence one felt when using a laptop in the group (H7).

Likelihood to multitask was significantly correlated with polychronicity level (H1) and managerial status (H3). Cohesion beliefs were anticipated to correlate with copresence management, productivity and the likelihood to multitask, but no statistical relationship was found. Cohesion beliefs and norms for technology use did produce a statistically significant relationship; highly cohesive teams perceived technology use amongst others to be appropriate (H6). However, since the construct of technology use had low reliability, this finding is considered weak at this point in the research.

The outcomes of Wave 1 reveal a complicated pattern of relationships: polychronicity proved a strong predictive construct, but cohesion beliefs and copresence management were not. In Wave 2, cohesion beliefs and copresence management are modified for a final time in order to increase their validity and reliability. These findings are discussed in the next section on Wave 2 with the online panel from Zoomerang. To summarize the final statistical correlations, Table 50 shows the findings for each of the major constructs numbered from 1 to 8 in the first column. The heading numbered 2 to 7 correspond with the same constructs in the column; columns 1 and 8 are removed for paper margin limitations.

	2.	3.	4.	5.	6.	7.
1. Polychronicity	***rho* = .316 *p* < .01** (H8)**		*rho* = .019 *p* > .05 (H4a)		***rho* = -.301 *p* < .01** (H7)**	**χ^2 = 14.13 *p* < .01** (H1)**
2. Perceived Productivity						
3. Cohesion Beliefs	*rho* = .021 *p* > .05 (H9)		*rho* = .080 *p* > .05 (H5)	***rho* = .203 *p* < .05* (H6)**		χ^2 = 3.76 *p* > .05 (H2)
4. Electronic Copresence						
5. Technology Use Norms						
6. Self-Efficacy of Technology Use						
7. Likelihood to Multitask						
8. Managerial Status						**χ^2=23.71, *p* < .001 *** (H3)**

*Correlation is significant at the .05 level
** Correlation is significant at the .01 level
*** Correlation is significant at the .001 level

Table 50: Summary Statistical Correlations - SoftwareCorp (Wave 1).

ZOOMTECH ONLINE PANEL SURVEY (WAVE 2)

This section discusses the results from the implementation of the survey with an online panel of information workers from across the United States provided by the Zoomerang Corporation, termed the ZoomTech panel here. The questionnaire (see Appendix D) used in this wave was longer than the one executed at SoftwareCorp (Wave 1) since there was no time restrictions with using the online panelists. Additionally, changes were made to the questionnaire on the constructs of cohesion beliefs and copresence management to improve the validity of these items.

Survey Context

250 respondents were solicited for this survey with the help of the Zoomerang Corporation and 110 complete responses were received. Zoomerang was selected as the company to provide access to respondents because they specifically offered a panelist set comprised only of people who work in technology fields. The sample size was chosen based on the maximum number of people allowable under researcher's budget. Respondents received "ZoomPoints" for participation which could be redeemed for gift certificates or products. For additional background information about the methodological issues with using online panels and Zoomerang, please see the limitations discussed in Chapter 3.

Questionnaire Modifications Based on Wave 1

The constructs of cohesion beliefs and copresence management were revised for this final survey as shown in Table 51 and Table 52, respectively. The cohesion construct was modified slightly, with the question about meeting coordination changed to remove the "not" in the middle of Q6c and the addition of Q12e. Q12e was added to balance the number of questions that dealt with task cohesion (Q12a, Q12b, and Q12c) compared to social cohesion.

Copresence management was more significantly altered. Two separate sub-scales were made in the new questionnaire, one to assess in-room copresence (Q5a-Q5d) and one to evaluate electronic copresence (Q6a-Q6f). The success of these questionnaire changes is discussed in the following sections on construct reliability and the factor analysis results.

SoftwareCorp Cohesion Beliefs Questions	Q6a. Team members make an effort to participate in meeting discussions. Q6b. Team members share the workload evenly. Q6c. My team does not coordinate our meeting activities very well. Q6d. It is important for me to be liked by other members of the team.
ZoomTech Panel Cohesion Beliefs Questions	Q12a. Team members make an effort to participate in meeting discussions. Q12b. Team members share the workload evenly. Q12c. Our team meetings are coordinated well. Q12d. It is important for me to be liked by other members of the team. Q12e. Overall, I feel like I am an essential part of my team.

Table 51: *Cohesion Beliefs* Questionnaire Changes.

SoftwareCorp Copresence Management Questions	Q9c. I respond to incoming instant messages while in a meeting. Q9d.I use my laptop during meetings to keep up communication with others outside of the meeting. Q10a. I tend to use my laptop for non-meeting related tasks (e.g. checking e-mail / working on other projects).
ZoomTech Panel Copresence Management Questions	Q5a. I try and make occasional eye contact with whomever is speaking. Q5b. I make a point to participate in the meeting discussion. Q5c. I nod my head slightly when I hear something that I agree with. Q5d. I lower or close my laptop screen when I'm done multitasking. Q6a. I notice all new incoming e-mail messages when in a meeting. Q6b. I write and respond to e-mail messages during a meeting. Q6c. I send instant messages to other people in the meeting who have laptops. Q6d. I send instant messages to work colleagues who are not in the meeting. Q6e. I won't initiate instant message conversations, but I will reply to incoming IMs. Q6f. I find it essential to be online throughout the meeting so that I can communicate with others who are not in the room.

Table 52: *Copresence Management* Questionnaire Changes.

Construct Reliability

The internal consistency of each research construct was tested by calculating Cronbach's coefficient alpha in SPSS (Scale > Reliability Analysis command). Table 53 shows that all of the constructs exceed the .70 cut-off criterion for acceptability, except for *technology use norms* and *self-efficacy of technology use*.

The technology use norms construct was also problematic in Wave 1, where it achieved a .581 reliability score. This construct needs additional modifications in future work since it appears to not represent the concept intended. Self-efficacy of technology use had previously achieved a coefficient alpha of .756 in Wave 1. Since the alpha value in Wave 2 is nearing the .70 mark, the construct is considered sufficient to continue to use in this analysis.

Research Construct	Cronbach's alpha
Polychronicity (Q15a, Q15b, Q15c, Q15d, Q15e)	.933
In-room Copresence (Q5a, Q5b, Q5c, Q5d)	.840
Electronic Copresence (Q6a, Q6b, Q6c, Q6d, Q6e, Q6f)	.814
Cohesion Beliefs (Q12a, Q12b, Q12c, Q12d, Q12e)	.809
Perceived Productivity (Q9a, Q9b, Q9c, Q9d)	.924
Technology Use Norms (Q14arev, Q14b)	.296
Self-Efficacy of Tech Use (Q8b, Q8c, Q8d)	.691

Table 53: Final Cronbach's alpha Values - ZoomTech (Wave 2).

Factor Analysis

The four-step factor analysis process used in Wave 1 was repeated with the Wave 2 data. The KMO test met the acceptability point of being larger than .70 and the Bartlett's Test for Sphericity was significant. The varimax rotated matrix identified 6 components from the questionnaire items, and these were organized into the following constructs as shown in Table 54. The questionnaire items are available in Appendix D.

Component	Construct	Items
1	Polychronicity	Q15a - .894 Q15b - .775 Q15c - .750 Q15d - .815 Q15e - .892
2	In-room Copresence	Q5a - .797 Q5b - .846 Q5c - .649 Q5d - .669
3	Cohesion Beliefs	Q7c - .790 Q12a - .708 Q12b - .579 Q12c - .736
4	Perceived Productivity	Q9a - .684 Q9b - .773 Q9c - .696 Q9d - .526
5	Electronic Copresence	Q6c - .788 Q6d - .854 Q6e - .838 Q6f - .699
6	Self-Efficacy of Technology Use	Q8b - .680 Q8c - .709 Q8d - .787

Table 54: Factor Analysis Constructs - ZoomTech (Wave 2).

The factor analysis calculated that six (6) components explained 72% of the variance in the model (see Table 55). As mentioned previously, an eigenvalue must be 1.0 or greater to be kept in the model and is an indicator of the amount of variance explained by the component (the larger the eigenvalue, the larger the variance explained). The newly reformulated cohesion beliefs and copresence management subscales were found to be unidimensional and have strong factor loading values on the associated scale items.

Component	Eigenvalue	% Variance
1	11.232	35.09%
2	3.919	12.25%
3	2.763	8.63%
4	2.090	6.53%
5	1.776	5.55%
6	1.418	4.43%

Table 55: Questionnaire Eigenvalues - ZoomTech (Wave 2).

Respondent Characteristics

The demographic characteristics of the ZoomTech respondents are shown in Table 56. A comparison of these demographics to the 2008 Pew Internet report on "Networked Workers" shows that the ZoomTech panel appears representative of today's information workers. This Pew report was selected as a comparison response set on the basis of topic similarity and shared focus on how people use technologies at work and at home.

The main differences with the ZoomTech panel are that it is skewed with having more male respondents, and more respondents are from Medium and Large size corporations. These demographic differences were expected since the screener criteria for the ZoomTech panel specifically requested participants who had technology-related job roles (which tend to be male-dominated) and worked at larger sized companies.

Characteristics	ZoomTech (n=110)	Pew Internet Respondent Characteristics (n=2,134)
Gender		
Female	37 (34%)	1,110 (52%)
Male	73 (66%)	1,024 (48%)
Age Range		
18 to 24 years old	1 (1%)	256 (12%)
25 to 34 years old	19 (17%)	384 (18%)
35 to 44 years old	40 (36%)	427 (20%)
45 to 54 years old	39 (35%)	427 (20%)
55 to 64 years old	11 (10%)	299 (14%)
65 years or older	0 (0%)	341 (16%)
Manager Status		
Manager	51 (46%)	896 (42%)
Non-Manager	59 (54%)	1,238 (58%)
Company Type		
Large Corporation	35 (32%)	640 (30%)
Medium Corporation	36 (33%)	832 (39%)
Small Business	13 (12%)	598 (28%)
Governmental Organization	12 (11%)	Unknown
Educational Organization	9 (8%)	Unknown
Non-Profit Organization	5 (4%)	Unknown
Length at Company		
2 years or less	17 (15%)	640 (30%)
3 to 7 years	48 (44%)	598 (28%)
8 to 15 years	26 (24%)	469 (22%)
16 years or more	19 (17%)	427 (20%)
Length in Job Role		
2 years or less	31 (28%)	832 (39%)
3 to 7 years	51 (46%)	619 (29%)
8 to 15 years	19 (17%)	384 (18%)
16 years or more	9 (8%)	277 (13%)
Typically Multitask with a Laptop in Meetings?		
Yes	46 (42%)	—
No	64 (58%)	

Table 56: Respondent Demographics - ZoomTech (Wave 2).

Data Overview

The same data process that was used in Wave 1 was used in Wave 2. The Likert scale responses from 110 participants were entered into SPSS. Only 46 respondents in the ZoomTech panel responded “yes” to the statement that they typically multitasked in meetings with a laptop; therefore the copresence, productivity and self-efficacy constructs were limited to these participants.

The summary data in Table 57 is comparable to the same overview from Wave 1 (see Table 42 on page 56). Both the ZoomTech panelists and SoftwareCorp employees scored similarly on average across all the major constructs. The SoftwareCorp employees had a similar polychronicity level (mean = 23.72) though a slightly larger percentage (49%) typically multitasked in meetings with laptops compared to 41% of the ZoomTech respondents.

Construct	n	Mean Score	SD	Range
Polychronicity	110	24.31	6.65	7 – 35
Cohesion Beliefs	110	4.94	1.01	3 – 7
In-room Copresence	46	5.45	1.13	1 – 7
Electronic Copresence	46	4.26	1.52	1 – 7
Perceived Productivity	46	5.68	.90	4 – 7
Self-Efficacy	46	3.90	1.33	1 – 7

Table 57: Construct Summary - ZoomTech (Wave 2).

SUMMARY OF FINDINGS (ZOOMTECH PANEL)

The same hypotheses tested with the previous survey wave of SoftwareCorp employees was used with the ZoomTech panel respondents. Since Wave 2 did not have the same time restrictions, the researcher included the survey item addressing Proposition 1. Additionally, since copresence management had been modified to delineate between in-room and electronic copresence, Hypothesis 4b was added to the analysis. To minimize redundancy in the discussion, see Wave 1 discussion pp. 185-196, for the rationales of the hypotheses.

Factors Contributing to Technology Multitasking (Theme 1)

Recalling both the qualitative research results and Pilot 1, there was indication in the data that the type of meeting one attended impacted the likelihood to multitask. Participants were asked to rate how frequently they multitasked across six meeting types: Staff Meetings, Internal Project Meetings, External Project Meetings, Lecture/Demonstration Meetings, Sales/Pitch, and Company "All Hands" Meetings.

> *P1: The context of the meeting (the meeting type) will influence the decision to multitask with technology.*

A Friedman's test compared the Likert scores of multitasking frequency across these meeting types with a significant result: $\chi^2(4, N = 46) = 9.80, p < .05$. The mean score for participants' responses to "How often do you multitask with a laptop computer during a [MEETING TYPE]?" is shown in Table 58 below. The respondents rated Internal Project Meetings, Lecture/Demonstration, and Staff Meetings as the meetings they most often technology multitasked, and Sales/Pitch, Company "All Hands," and External Project Meetings were ranked with lowest frequency of multitasking

Meeting Type	**Mean**	**Standard Deviation**
Internal Project Meeting	5.30	1.26
Lecture/Demonstration	5.02	1.61
Staff Meeting	4.93	1.51
Sales/Pitch	4.67	2.15
Company "All Hands"	4.18	2.19
External Project Meeting	4.14	1.84

Table 58: Multitasking Frequency by Meeting Type.

A post-hoc analysis with the Wilcoxon Signed Rank Test identified which meeting types were significantly different in multitasking frequency. The z-scores and significance values are shown for each significant paired comparison from the Wilcoxon results, indicating that respondents differed in their frequency of multitasking between these two meeting types. In Table 59 below, the meeting type listed first for each pair indicates the meeting type with a higher multitasking frequency (e.g. Staff Meeting had higher rates of multitasking as shown in the first two rows).

Meeting Type Comparison	Z Score	Significance
Staff Meeting External Project Meeting	-2.47	.013
Staff Meeting Company "All Hands"	-2.46	.014
Internal Project Meetings External Project Meetings	-4.04	.000
Lecture/Demonstrations External Project Meetings	-2.31	.021
Internal Project Meetings Company "All Hands"	-3.67	.000
Lecture/Demonstration Company "All Hands"	-2.23	.026

Table 59: Wilcoxon Post-Hoc for Meeting Type & Multitasking Frequency.

The Wilcoxon post-hoc analysis confirms the surface analysis based on the mean scores in Table 58. Participants technology multitasked the least in External Project Meetings and Company "All Hands" while multitasking the most in Staff, Internal Project, and Lecture/Demonstration meetings.

Transitioning from multitasking frequency based on meeting type, the next set of variables looks at individual factors impacting the likelihood to multitask (polychronicity and managerial status). Polychronicity scores were normally distributed in Wave 2, excluding 12 respondents who reported a score of 35 as shown in Figure 16.

> *H1: Individuals high in polychronicity will multitask with technology more than those low in polychronicity.*

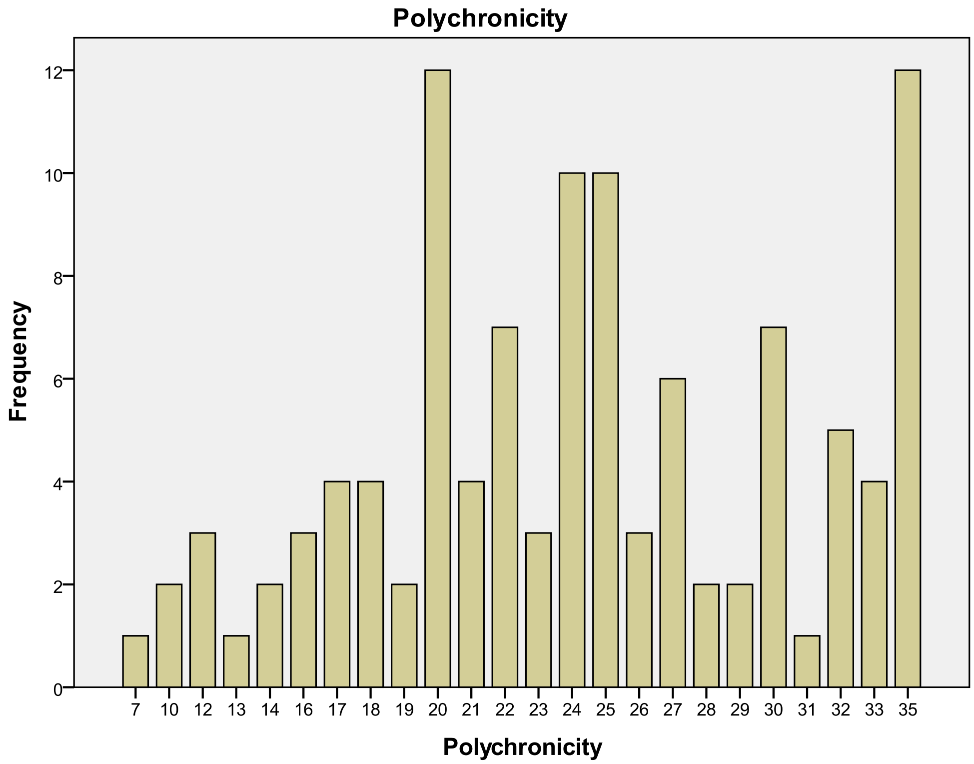

Figure 16: Polychronicity Score Bar Chart - ZoomTech (Wave 2).

A chi-square test for significance of polychronicity level and laptop use in meetings found a non-significant result using the same 4-group category used in Wave 1: $\chi^2(3, N = 110) = 5.58, p > .05$. As shown in Table 60, only those in the Medium-Low (13 to 20) category exhibit any significant difference in likelihood to multitask based on polychronicity level. These results contradict the finding in Wave 1, where a linear relationship was found (the higher the polychronicity score, the higher the likelihood to multitasking during meetings).

		Polychronicity Level				Total
		5 to 12	13 to 20	21 to 28	29 to 35	
Q3. Do you typically use a laptop computer during project meetings?	Yes	3	7	19	17	46
	No	3	21	26	14	64
Total		6	28	45	31	110

Table 60: Cross-tab for Polychronicity & Tech. Multitasking - ZoomTech.

However, when re-grouping the polychronicity levels into three clusters instead of four, the interpretation of the data changed to significant results (see Table 61 below). When using clusters based on either the natural breaks in Figure 16 or three equal sized clusters, Hypothesis 1 became significant for the ZoomTech panel. Since Wave 1 also achieved significant results regardless of the clustering levels used, this conflict within the interpretation for how polychronicity score correlates with likelihood to multitask may be a reflection of sampling issues or a random pattern that would wash out with additional data collection.

In order to determine whether to accept the ZoomTech panel data as significant or not for H1, an independent samples t-test was also used. A significant result was found: $t(108) = 2.46$, $p < .05$ giving confidence to the interpretation that polychronicity level did impact the likelihood to multitask in both survey waves.

Polychronicity Groupings	**Chi-Square Results**
Natural Breaks in Histogram: Low (5 to 19) Medium (20 to 26) High (27 to 35)	$\chi^2(2, N = 110) = 5.85, p = .05$
Three Groups: Low (5 to 14) Medium (15 to 25) High (26 to 35)	$\chi^2(2, N = 110) = 7.18, p < .05$

Table 61: Additional Polychronicity Analyses - ZoomTech (Wave 2).

H3: Managers will multitask with technology more than non-managers.

A chi-square test for significance of manager status and laptop use in meetings found a significant result: $\chi^2(1,\ N = 110) = 8.84$, $p < .01$. Fifty-one of the 110 respondents self-identified as managers, and of those 51, 29 indicated that they typically multitask in meetings (57%). Of the 59 non-manager respondents, only 17 indicated that they multitask in meetings (29%). Managers were twice as likely to technology multitask. This rate of managerial multitasking is lower than that indicated in Wave 1 (77% of managers in Wave 1 multitask), but the finding is still significant.

H2: Individuals who feel highly cohesive with their teams will multitask less.

A chi-square test for significance of cohesion beliefs and laptop use in meetings found a significant result: $\chi^2(2,\ N = 110) = 15.32$, $p < .001$, however, the direction of these results were contrary to the research hypothesis. The cohesion scores were divided into three groups, Low (10 to 15), Medium (16 to 21), and High (22 to 28) in order to create larger groupings for the cohesion scores; these clusters were based on the natural breaks of the scores shown in Figure 17.

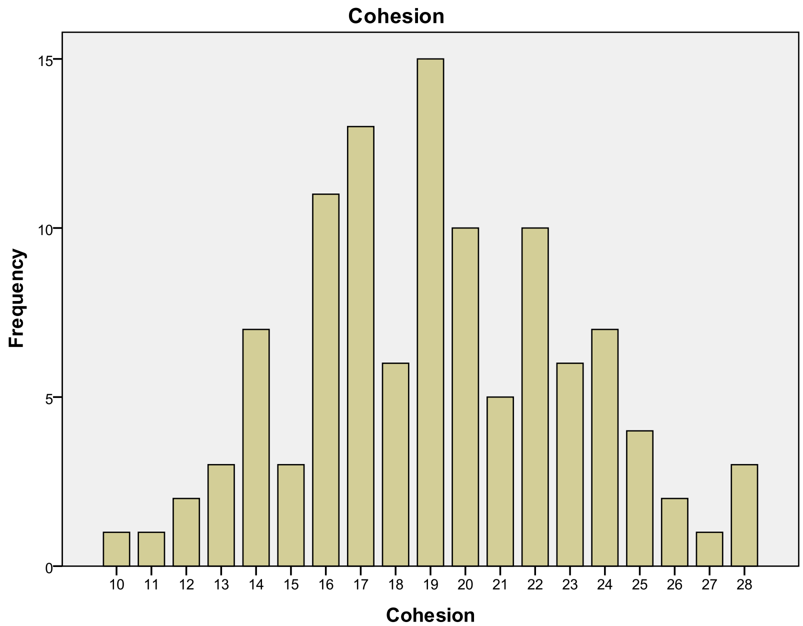

Figure 17: Cohesion Score Bar Chart - ZoomTech (Wave 2).

The post-hoc analysis of the residuals indicated that those in the High cohesion beliefs group were more likely to multitask in meetings than those in the Low and Medium cohesion levels. An additional analysis was completed using four clusters (Low 10-14, Medium 15-19, High 20-24, and Very High 25-28) and the same significant result was maintained.

Hypothesis 2 originally predicted that those in the High cohesion group would be less likely to multitask, but the opposite result was found. This suggests that individuals who are cohesive with their teams feel more comfortable multitasking in front of them. The cohesion results reported in Wave 2 cannot be directly compared to Wave 1 since the questionnaire items were revised based on the previous low reliability score for cohesion.

Behavioral Changes in Mixed Reality (Theme 2)

In Wave 1, no significant results were found for how polychronicity and cohesion beliefs correlated with copresence management. The copresence construct was revised in Wave 2 to demarcate electronic copresence and in-room copresence as two separate constructs. This change resulted in the following significant findings for Hypotheses H4a and H5 in Wave 2.

H4a: Individuals high in polychronicity will manifest greater electronic copresence.

A significant result was found indicating that polychronicity and electronic copresence have a moderate relationship (Spearman's *rho* value = .346 with $p < .05$). Electronic copresence questionnaire items asked respondents to rate their agreement level on questions pertaining to noticing and responding to e-mails and instant messages during a meeting. This finding suggests that individuals with a propensity to multitask will use technology multitasking primarily for maintaining communication with those outside of the meeting. The significance of this finding is that technology multitasking is not just about getting other work done during a meeting, but specifically other work that requires communication via electronic communication tools.

H4b: Individuals low in polychronicity will manifest greater in-room copresence.

A non-significant result was found indicating that polychronicity and in-room copresence have no relationship (Spearman's *rho* value = .280 with $p > .05$). This finding indicates that polychronicity does not impact one's participation level in a meeting. Comparing this finding to the qualitative results, the interview participants were similarly not able to recall in-room copresence behaviors despite the researcher observing instances of it during SoftwareCorp meetings. This suggests that in-room copresence may not be a construct that is easily captured using recollection, and that future studies should rely on observations of real world behaviors.

> *H5: Individuals who feel cohesive with their immediate team will have greater in-room copresence.*

A significant result was found indicating that cohesion and in-room copresence have a strong relationship (Spearman's *rho* value = .645 with $p < .001$). This finding suggests that cohesion beliefs were an indicator of meeting relevancy. As discussed in Chapter 4, meetings that were more relevant to the participant were more likely to encounter increased participation by the user (in-room copresence). In summary, the changes to the Wave 2 questionnaire, specifically for *cohesion beliefs* and *copresence management* helped identify significant results in the way people perceive their behaviors in mixed reality.

Attitudes Toward Mixed Reality Behavior (Theme 3)

In Wave 1, cohesion beliefs were found to significantly correlate to the attitude that others in the team multitasked appropriately with technology. This same finding was found in Wave 2, with an even more significant *rho* value which can be attributed to the revision of the cohesion beliefs construct.

> *H6: Individuals who have high cohesion beliefs will perceive appropriate multitasking from others.*

A significant result was found indicating that cohesion and technology use norms have a moderate relationship (Spearman's *rho* value = .368 with $p < .001$).

For Hypothesis 7, Wave 1 resulted in a significant finding indicating that individuals higher in polychronicity have higher self-efficacy in regards to their technology use. This same finding was not supported in Wave 2, a non-significant result was found indicating that polychronicity and self-efficacy have no relationship (Spearman's *rho* value = .232 with $p > .05$).

> *H7: Individuals high in polychronicity will have higher self-efficacy about their technology multitasking.*

One possible explanation for the lack of a significant finding in Wave 2 is due to the fact that *self-efficacy of technology use* questions were not the same across the two waves. Recalling that this construct was not identified until after data collection had been completed (it was created during the factor analysis), the items associated with *self-efficacy* in Wave 2 was missing: "When my boss or supervisor is in the meeting, I use my laptop less." It was not known at the time Wave 2 was implemented that this item would be used in a future construct. While the results for H7 are not comparable across the two waves, since this construct emerged from the research and was not part of the original focus, this result does not seriously impact the presentation.

Mixed Reality Meeting Outcomes (Theme 4)

In Wave 1, the respondents who were high in polychronicity significantly correlated to perceiving increased productivity with technology multitasking. The same result held in Wave 2.

> *H8: Individuals high in polychronicity will perceive meetings as more productive when technology multitasking occurs.*

A significant result was found indicating that polychronicity and productivity have a moderately strong relationship (Spearman's *rho* value = .587 with $p < .001$).

For cohesion beliefs and perceived productivity, in Wave 1, a non-significant result was found (which may have been due to the low reliability score of the cohesion beliefs construct).

> *H9: Individuals who feel cohesive with their team will perceive lower productivity when technology multitasking occurs.*

In Wave 2, a significant result was found for cohesion beliefs and productivity; however the results were contrary to the research hypothesis. As can be seen in Figure 18 below, there is a positive linear relationship between the two constructs: as cohesion beliefs increase so do beliefs about productivity. A significant result was found indicating that cohesion and productivity have a moderately strong relationship (Spearman's *rho* value = .722 with $p < .001$).

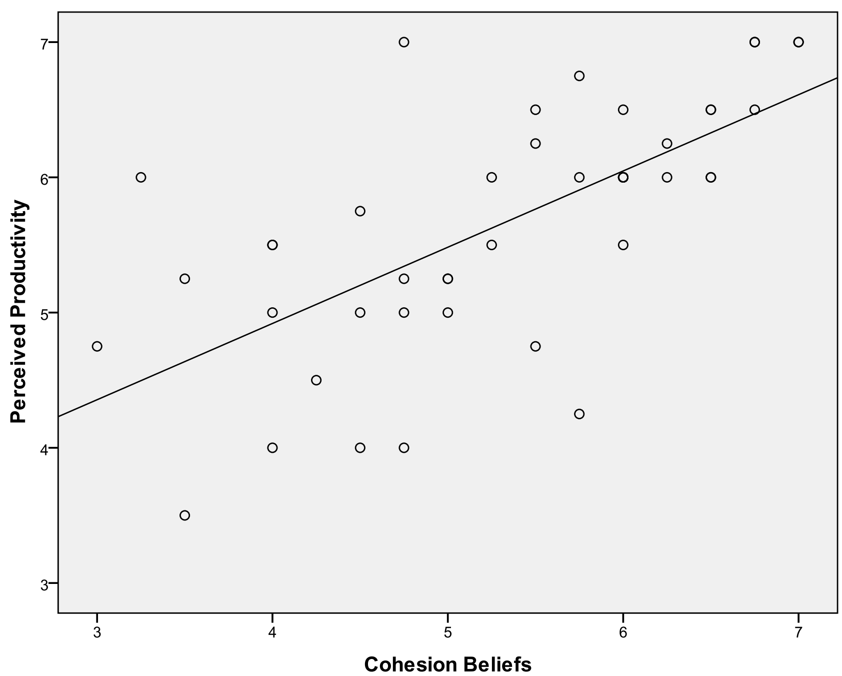

Figure 18: Cohesion and Productivity Scatterplot - ZoomTech.

Summary of ZoomTech Panel Results

Table 62 summarizes the correlations for the hypotheses described in Wave 2. The row headings (2, 4-8) correspond to the numbered items in the first column; columns 1, 3, 9, and 10 are removed for paper margin limitations.

	2	4	5	6	7	8
1. Polychronicity	***rho* = .587 *p* < .001*** (H8)**	***rho* = .346 *p* < .05* (H4a)**		*rho* = .232 *p* > .05 (H7)	**χ^2 = 7.18 *p* < .05* (H1)**	*rho* = .280 *p* > .05 (H4b)
2. Perceived Productivity						
3. Cohesion Beliefs	***rho* = .722 *p* < .001*** (H9)**		***rho* = .368 *p* < .001 (H6)**		**χ^2 = 15.32 *p* < .001*** (H2)**	***rho* = .645 *p* < .001*** (H5)**
4. Electronic Copresence						
5. Technology Use Norms						
6. Self-Efficacy of Technology Use						
7. Likelihood to Multitask						
8. In-room Copresence						
9. Meeting Type					**χ^2 = 9.80 *p* < .05* (P1)**	
10. Managerial Status					**χ^2 = 8.84 *p* < .01** (H3)**	

*Correlation is significant at the .05 level
** Correlation is significant at the .01 level
*** Correlation is significant at the .001 level

Table 62: Statistical Correlations - ZoomTech (Wave 2).

CONCLUSION

Chapter 5 presented the results from the survey data collection on the topic of mixed reality. The complete data set comprised of four survey iterations, two pilots (Pilot 1 & Pilot 2) and data collection with two sets of information workers (Wave 1 at SoftwareCorp and Wave 2 with an online panel from Zoomerang). The results yielded a validation of 7 of the 10 research hypotheses as shown in Table 63.

The hypotheses which had unequivocal support across both survey waves are H1, H3, H6, and H8. For hypotheses H1 and H3, polychronicity level and managerial status were each positively correlated with a propensity to technology multitask in meetings.

Hypotheses H4a, H5, and H7 had conflicting results between the two survey waves, with support found in one wave but not the other. H4a and H5 produced significant results in Wave 2 because the constructs of *cohesion beliefs* and *copresence management* were revised and the validity of these constructs was significantly improved. H7 is not significant in Wave 2 because the construct *technology use norms* reliability score was only .296 (whereas it had been .581 in Wave 1). The reliability score was not strong in Wave 1 and proved further problematic in Wave 2 though no changes had been made to the questions.

And finally, H2 and H9 were found to be significant in Wave 2 but the results were contrary to the hypotheses. Cohesion beliefs had been anticipated to lower people's beliefs about multitasking frequency and perceptions of productivity, however, the opposite was found. The contrary results of H2 and H9 do match findings from the qualitative results at SoftwareCorp. During the fieldwork analysis, the researcher had observed that Sam had high cohesion with his teams but multitasked frequently. The next and final chapter concludes with a discussion of these quantitative results in relation to the qualitative work and a discussion of the implications of this research.

Research Hypothesis	**Wave 1**	**Wave 2**
P1: The context of the meeting (the meeting type) will influence the decision to multitask with technology.	——	Supported
H1: Individuals high in polychronicity will multitask with technology more than those low in polychronicity.	Supported	Supported
H2: Individuals who are highly cohesive with their teams will multitask less.	Not Significant	Significant, but in wrong direction
H3: Managers will multitask with technology more than non-managers.	Supported	Supported
H4a: Individuals high in polychronicity will manifest greater electronic copresence.	Not Significant	Supported
H4b: Individuals low in polychronicity will manifest greater in-room copresence.	——	Not Significant
H5: Individuals who feel cohesive with their immediate team will have greater in-room copresence.	Not Significant	Supported
H6: Individuals who feel cohesive with their team will believe that others on their team multitask appropriately.	Supported	Supported
H7: Individuals high in polychronicity will have higher self-efficacy with technology multitasking.	Supported	Not Significant
H8: Individuals high in polychronicity will perceive meetings as more productive when technology multitasking occurs.	Supported	Supported
H9: Individuals who feel cohesive with their immediate team will perceive less productivity with technology multitasking.	Not Significant	Significant, but in wrong direction

Table 63: Overview of Hypotheses Supported - Wave 1 & Wave 2.

CHAPTER 6: *DISCUSSION AND CONCLUSION*

This chapter concludes the dissertation with a discussion of the contributions and limitations of this research. The implications of the work are presented in terms of theoretical placement, extending related research, and practical managerial application. The limits of this research are identified and recommendations for future work are proposed along with final concluding thoughts.

RESEARCH SUMMARY

This dissertation seeks to understand meeting settings where information workers engage simultaneously in both face-to-face group activities and other work tasks performed on laptops. This layering of multiple work activities incorporating the physical engagement of meeting in combination with computer-based virtual tasks was termed *mixed reality*. This mode of work is relatively understudied by researchers examining technology use in meetings as outlined in Table 64 below; for a review of the studies cited refer to the literature review in Chapter 2.

Prior Research on Technology Use in Meetings	Contrasting Mixed Reality Meetings Research
All group members use the same technology (Baecker, 1995; Stefik et al., 1988)	Not all group members use technology
Common/explicit purpose for how technology is supporting the meeting (Halonen et al., 1990)	No explicit rules for how and when technology use occurs in the meeting
Little or no emphasis on how others are impacted by someone's technology use (Scott, 1999)	Focus on how both the individual user and others are impacted by technology use
Technology is studied as it supports and helps the meeting task (Scott, 1999)	Technology both supports and distracts from the meeting task

Table 64: Prior Studies of Technology Use vs. Mixed Reality Research.

The research presented here on mixed reality advances our knowledge by specifically exploring how individuals managed work tasks that both competed and supplemented each other in a group environment. The research findings were organized by four themes which encompassed a broad view of mixed reality by including: (1) the motivating individual and group factors for when and why people multitask with technology in meetings, (2) the behavior of group members in mixed reality, (3) attitudes toward technology multitasking, and (4) the perceived outcomes of this behavior on perceived productivity and meeting satisfaction.

This research identified meeting context (defined by the type of meeting one attended based on purpose) as one of two primary factors influencing people's decision to use laptops during meetings. Workplace meetings are not a single category of activity that are the same across an individual's job; each of the meeting types identified by the participants had a set of behavioral norms associated with them. Essentially, participants entered into a given meeting type (e.g. an internal project meeting) with an implicit understanding of perceived appropriate meeting behavior; however when contextual details of the meeting type changed, particularly who else was present and the topics being covered, people deviated from these norms.

Three main meeting types are most common to information workers in this study: staff meetings, internal project meetings, and external project meetings. Of these three meeting types, internal project meetings were cited as being the type with the most technology multitasking. Participants reported there was an acceptable work-related reason to multitask during internal project meetings, but not with staff meetings (even if the same individuals in attendance overlapped amongst these types.) The decision to multitask based on meeting type was shaped by social expectations of acceptability and familiarity though relevance of the meeting topic could also shift behavior.

Highly relevant meeting topics resulted in a decrease in technology multitasking, and less relevant topics resulted in increased multitasking as participants sought to utilize their time more efficiently. Research has demonstrated a link between task relevance and motivation to learn (Frymier & Shulman, 1995) and goal setting theories have identified that when people have multiple competing goals, more resources are allocated to the difficult goal (Erez, Gopher, & Arzi, 1990). These findings connect to the mixed reality qualitative results; participants described how when meeting discussions were highly relevant to their job they were less likely to multitask because they needed to learn from the group conversation. And, when Charles's internal project meeting was observed struggling with a complex decision task, multitasking immediately decreased as attendees focused all of their attention on the meeting discussion.

Following meeting type, the second major factor determining technology use was individual differences based on multitasking preference (polychronicity). In survey Wave 1 at SoftwareCorp, individual differences mattered at the extremes. People categorized as "high" in polychronicity almost always used laptops during meetings, while people "low" in polychronicity rarely, if ever, multitasked with technology. The survey questionnaire specifically asked people if they *typically multitasked with a laptop* in meetings, and not just if they brought a laptop with them to the meeting. However, those individuals who scored in the middle range of polychronicity level were equally likely to be in either category (of multitasking with a laptop or not). In terms of how comfortable and proficient multitaskers felt about their ability to multitask during meetings, those in the higher polychronicity range in Survey Wave 1 rated high in self-efficacy, but the same result was not found in Wave 2. High polychronicity individuals also believed they were more productive when they multitasked with a laptop during meetings, though it must be emphasized that this is a subjective belief not supported by empirical data. However, previous research (e.g. Leaman & Bordass, 2000) has found that perceived productivity does correlate with actual measurable productivity (measurable work outputs).

Polychronicity predicts the likelihood that one multitasks in a meeting and it positively correlates with perceptions of productivity. In both survey waves, a significant correlation was found for polychronicity and perceived productivity: in Wave 1, *rho* = .316 and in Wave 2, *rho* = .722. However, previous research studies on the relationship between polychronicity and performance have found no correlation between the two variables, such as Conte, Rizzuto, & Steiner's (1999) analysis of polychronicity orientation and student college performance (measured by GPA). Bluedorn & Denhardt (1988), on the other hand, found polychronicity can enhance productivity under certain conditions (such as time constraints).

While not a primary factor in the conceptual model, job role also influences who is likely to multitask during meetings. People whose roles involve communicating with multiple different groups of people were more likely to multitask in meetings than those who do not. In this research, information workers who had a managerial role (daily supervision of multiple employees) multitasked during meetings significantly more than those in non-managerial positions. This finding suggests that using electronic communication tools such as instant messaging and e-mail are more common than using other work tools while multitasking. However, additional research is needed to identify whether e-mail and instant messaging are used more frequently while multitasking because of managers numerous communication needs or because these activities are suited to mixed reality due to the lower level of attention required.

Turning to examine behavior in mixed reality, participants who multitasked on non-meeting tasks stated that they tended to do so only in sections of the meeting they judged to be less relevant to them. This means that people made a conscious effort to focus on the meeting when they felt it was relevant, and then utilize laptops in the "down time" of the meeting. In their view, this was not true multitasking, but rather task switching in short bursts depending on what participants felt needed their focus at the moment.

In terms of attitudes toward group relationships when technology multitasking, it was hypothesized that the closer bond one felt toward one's team, the less likely one would be to multitask. However, the opposite finding occurred: team members who rated themselves as feeling highly cohesive with their teams were more likely to technology multitask during meetings. In essence, the more familiar you are with the people in the meeting, the more comfortable you are with technology multitasking in that setting. Furthermore, teams that were highly cohesive were more likely to rate that others on their team knew how to appropriately multitask. The less familiar you were with someone, the more likely you were to cite them as being inappropriate multitaskers; non-familiars were believed to be showing off or pretending they were busy when multitasking. This suggests multitasking operates under a group protocol, whereby a certain level of trust and familiarity within the group is required and at which point, its occurrence is sanctioned.

In studying the impact of technology multitasking on meeting outcomes, high polychronicity individuals believe they are more productive during meetings. This is a subjective belief about productivity and future research should address actual measurable gains. In this research the measure of meeting satisfaction was conflated with perceived productivity and hence it is not possible to ascertain whether people are happier in meetings due to multitasking. Some of the interview data suggests that there are non-multitaskers who find it extremely rude and distracting when others multitask during meetings, however this finding was limited to two of the eight interview participants.

Do the outcomes from mixed reality meetings suffer as a result of task-switching that occurs from technology multitasking? While interview participants discussed how occasionally they missed hearing a piece of information in a meeting because they were distracted, overall they perceived that the goals of the meeting were not adversely impacted due to technology multitasking. Since the information relayed in meetings has redundancy checks through multiple members and meeting leaders sending out follow-ups afterwards, actual work outcomes do not seem to be negatively impacted by distracted workers. In one meeting instance observed at SoftwareCorp, where critical decision making was occurring, all multitasking stopped of people's own accord. Information workers seem to self-regulate their behavior when recognizing critical meeting discussions. However, future work may want to consider how decision making and groupthink are impacted when members do not realize that critical discussions are occurring while they are task-switching. In the next section, a placement of the research findings in relation to psychological studies of multitasking and computer-supported cooperative work is presented.

RELATIONSHIP TO OTHER RESEARCH

There are two main bodies of research that relate to the findings presented in this dissertation: psychological studies on the cognitive impacts of multitasking and research in the area of computer-supported cooperative work (CSCW). This section discusses the dissertation results in context of these related works by examining how this research builds upon and differs from these works, specifically addressing these questions:

1. How do psychological studies of multitasking compare to the findings in this research?
2. How are the constructs of cohesion and copresence different in mixed reality compared to prior work in CSCW?

Individual Differences in Multitasking Ability

This section discusses how individual differences toward technology multitasking impact performance outcomes. Recalling the research findings, polychronicity proved to be a significant construct in predicting the likelihood that one multitasked during meetings, and based on the qualitative findings it further indicated the likelihood that one would multitask on tasks unrelated to the meeting. Furthermore, individuals high in polychronicity perceived themselves as being proficient at multitasking and as being more productive in meetings. Studies which address the impact of multitasking on overall cognitive functioning are presented first, followed by an examination of how individual differences influence performance outcomes when multitasking.

Psychological research has examined cognitive functioning in relation to fragmented tasks and reported negative outcomes for neurological functioning. Experimental research on task-switching by Rubinstein, Meyer, & Evans (2001) found that individuals are not only slower at switching between challenging tasks, but that it is also fatiguing and stressful to the brain. Foerde, Knowlton, & Poldrack (2006) discovered that learning is more difficult when multitasking because different parts of the brain are used that hinder information storage and retrieval. The hippocampus of the brain is used for storing and processing declarative memories, which are memories created from factual information. The striatum, on the other hand, stores and processes procedural memories such as how to ride a bike or play a familiar song on the piano. Information in the striatum is task and context specific, whereas information in the hippocampus is generalizable for multiple contexts. When individuals try to learn while multitasking, only the striatum is activated and the learned information becomes linked to the specific context and is less valuable outside of these contexts.

While the research just discussed focuses on multitasking in general, are there classes of individuals who are more proficient at multitasking and if so, are they able to overcome the pitfalls associated with multitasking? Research on multitasking and its impact on cognitive ability by Ophir et al. (2009) found that people who were categorized as “heavy media multitaskers” had decreased task-switching ability than individuals who were “light media multitaskers”. Media multitasker level was defined by the mean number of media an individual consumes. This study tested participants’ cognitive performance with experimental tasks using a computer simulation (example tasks included identifying whether a rectangle shape had changed in orientation). High media multitaskers were less able to ignore distracting information presented in the computer simulation which the researchers concluded meant that HMMs were more likely to allow irrelevant information into working memory. Therefore, Ophir et al. deduced that LMMs were better able to ignore distracting information. However, these differences may also be attributable to underlying cognitive styles which are merely reflected in media consumption habits.

Research from Zhang, Goonetilleke, Plocher, & Liang (2005) further demonstrates the contradictions toward analyzing performance based on individual differences. Zhang et al. tested groups of polychronic and monochronic-oriented individuals on visual search and math calculation tasks and found that there were no differences between the two groups when the task pacing was controlled by the participant. However, when a timed trial was introduced, polychronic individuals demonstrated increased accuracy. The implication of this finding is that it appears under certain conditions (perhaps based on task difficulty or heightened stress) that polychronic individuals can perform better.

Overall, the psychological research on multitasking as it relates to individual performance finds that multitasking decreases cognitive performance. However, when studies categorized individuals based on their preference for multitasking, conflicting results are found for performance outcomes. Ophir et al.'s work suggests that polychronic individuals (labeled as high media multitaskers) have a difficult time ignoring distracting information which leads to decreased performance. Zhang et al., on the other hand, find that polychronic individuals have heightened functioning under time constraints and can outperform those lower in polychronicity.

One issue with comparing psychological research on multitasking to this research on mixed reality is that the task types do not compare directly. In the psychological studies, participants perform two tasks that are unnatural to most information work (example tasks include multiple sets of math calculations and visualizing abstract shape transformations). In mixed reality, the cognitive capacity needed to listen to meeting attendees while browsing e-mail does not require the same level of concentration nor does it occur with the same time pressure or skill set. However, despite the task type differences, this research extends the psychological experiments by identifying additional variables and situational constraints for future research. This research can inform the work of psychological researchers with recommendations to include the following:

- How well do individuals perform listening tasks while browsing/scanning electronic information? Are certain classes of individuals, such as those high in polychronicity, more adept during this form of multitasking?

- How long can individuals actively participate in a conversation while browsing/scanning electronic information before a decline in performance or attention?

- What are the cognitive differences between participating in dyadic conversations while multitasking compared to participation in small group conversations (3 to 8 individuals)?

- How much attention do bystanders give to the behavior of those who are multitasking? To what extent is the bystander's performance impacted when others are multitasking?

While the current psychological studies that assess multitasking have identified performance losses through increased stress, increased task time and deficient memory storage, it is not possible to conclude at this time that these same outcomes occur in mixed reality.

Cohesion and Copresence in Mixed Reality and CSCW

The underlying tenet of computer-supported cooperative work (CSCW) research is that technology is an enhancement to group work (Greif, 1988). While CSCW focuses on evaluating and analyzing groups and technology there remains a lack of consistency amongst these studies. Contradictory findings exist in regards to group satisfaction, meeting efficiency, team effectiveness, and whether decision-making is improved when technologies are used by groups (Scott, 1999). This variety in the findings points to the importance of context variables such as characteristics of team members, the type of technology being used, and the nature of the task itself when discussing the results. The purpose of this section is to compare the mixed reality research constructs of *cohesion beliefs* and *copresence management* to the relevant bodies of work from CSCW researchers.

Cohesion Beliefs

Cohesion beliefs were found to be a positive indicator with likelihood to multitask and how comfortable one felt multitasking in front of others. The reason for this finding is that highly cohesive groups already have established rapport with each other through informal interactions and a shared history in their workplace. Familiarity with coworkers allowed users to perceive multitasking as acceptable, because those who technology multitasked had opportunities to demonstrate commitment and engagement with the group task outside of the meeting context.

Groups that are cohesive demonstrate coordinated patterns of behavior and focus more attention on each other (Thompson, 2002). However, in mixed reality settings, technology multitasking diminished the similarity of behavior amongst group members and the amount of visual attention between members. The observations at SoftwareCorp and interview data found that for any small group meeting (ranging from 4 to 12 people), only about half of the meeting attendees technology multitasked. And, in the minute-by-minute breakdown of multitasking by Sam and his Director described in Chapter 4, the majority of their time spent in the meeting was looking at the laptop; though both were extremely committed to the goals of the group and the meeting at-hand.

This conflict in the findings suggests that group cohesion in face-to-face meetings must be assessed beyond physical patterns of coordination and gaze. Physical behaviors of group members have changed due to technology multitasking, and therefore cohesion measured solely on meeting interactions will give a limited and inaccurate view in future research.

Copresence Management

The behavior of individuals in mixed reality meetings consisted primarily of task switching between using a laptop momentarily to check e-mail or answer instant messages and attending to the meeting discussion. To a lesser extent, some individuals were observed being fully disengaged from mixed reality meetings by immersing themselves with technology for extended periods of time, however this was not typical. Overall, participants who multitasked made attempts to demonstrate that they were still involved with the meeting by participating out loud and looking up from their laptop computers after every momentary use of the laptop. Why did copresence management persist, even when participants had additional work contexts in which to demonstrate their engagement with their role and projects (as noted in the previous section on cohesion beliefs)?

Mixed reality meetings engender diverse attitudes on the appropriateness of the behavior because people have conflicting goals and expectations about meeting protocol. One of the key components of face-to-face meetings is the ceremonial or symbolic function that they serve. Meetings are not just held to exchange information between multiple individuals; they also serve as a way for people to demonstrate commitment to the project and help build rapport amongst group members through small talk and informal chatter (Jay, 1976; Nardi & Whittaker, 2002). Participant 8, a manager of web services for a large bank, explained meetings were very important in her organization because they served to harness everyone into committing to a course of action.

This tacit understanding of the social purpose of meetings means that in typical bouts of multitasking, people felt compelled to show that they were engaged with the group task. No participants believed it was appropriate to attend a meeting and not participate (even if you were diligently listening the whole time). A tension between the social needs of the group occurs with the informational needs of the user resulting in people purposefully participating. Copresence management serves to facilitate increased information exchange amongst group members and a common sharing of experience. However, for those who multitask during meeting, electronic copresence management also occurred throughout meetings as users felt obliged to respond to electronic messages.

Turkle (2008) identifies the concept of a "tethered self" – where one's multiple roles (professional information worker, mother/father, friend, mentor, and so on) are available to everyone through the portable devices that are carried by most people. These electronic connections can overshadow the needs of those physically present because of the sense of urgency people attribute to electronic communication. The outcome of this tethered self is that people can reach validation and have a "back up" support system in place at all times (and conversely these individuals must support incoming requests from other tethered selves). For information workers, this means that electronic messages are noticed and attended to more so than the topics being addressed in the physical realm.

Even in the early 1990s this pattern of favoring electronic communication over verbal communication occurred. As exhibited in Markus's (1994) work about the unintended consequences of e-mail use, even when e-mail was not purposefully being used in "bad" ways (people were not trying to sabotage or avoid work tasks), e-mail intruded on and impacted other forms of work communication. In the context of

Markus's study, e-mail was intended to be used in the workplace to minimize phone interruptions. However, if e-mails did not receive an immediate response, the sender would then follow-up their request with a phone call, which negated the intended purpose for e-mail. To avoid the follow-up phone call, people felt compelled to respond to e-mails immediately, which in turn caused people to favor answering e-mails even over face-to-face conversations.

As portable technologies continue to proliferate in face-to-face settings, it will become even more relevant to assess the frequency and extent to which electronic copresence occurs. This research has contributed to the field of CSCW by creating a validated copresence management scale that measures both copresence with those physically present and electronic copresence. As outlined in the literature review, the copresence construct is primarily attributed to sociologist Erving Goffman (1959). It has since been used in current technology-focused research as a measure of how individuals in virtual reality environments perceive the "salience of others in mediated communication and consequent salience of their interpersonal interaction" (Short, Williams, & Christie, 1976).

To date, there exist few scales that have made an attempt to measure the frequency with which individual behavior contributes to the level of copresence. Previous work, particularly Nowak & Biocca (2003), have measured copresence but not at the behavioral level. Rather, the Nowak & Biocca scale measures impressions of how close or distant a communication partner feels with the person they are interacting with.

Example questions from their scale include the following Likert-scale items:

- I was interested in talking to my interaction partner.
- My interaction partner acted bored by our conversation.
- My interaction partner communicated coldness rather than warmth.
- I wanted to maintain a sense of distance between us.

The questions used in this research, on the other hand, are not based on impressions between communication partners as a representation of copresence, but rather focus on the behavioral mechanisms by which this copresence is created or maintained. The copresence scale developed here measures individual behaviors with those who are present and also with virtual communication partners (see Table 65 below). The Cronbach's alpha value for in-room copresence was .840 and the value for electronic copresence was .814.

Copresence Management Questions	Please rate your agreement level with the following statements when multitasking with a laptop during meeting: *In-Room Copresence* Q5a. I try and make occasional eye contact with whoever is speaking. Q5b. I make a point to participate in the meeting discussion. Q5c. I nod my head slightly when I hear something that I agree with. Q5d. I lower or close my laptop screen when I'm done multitasking. *Electronic Copresence* Q6a. I notice all new incoming e-mail messages when in a meeting. Q6b. I write and respond to e-mail messages during a meeting. Q6c. I send instant messages to other people in the meeting who have laptops. Q6d. I send instant messages to work colleagues who are not in the meeting. Q6e. I won't initiate instant message conversations, but I will reply to incoming IMs. Q6f. I find it essential to be online throughout the meeting so that I can communicate with others who are not in the room.

Table 65: In-room & Electronic Copresence Scale Items.

The copresence scale developed here is intended to be useful for any research that wants to address communication availability in competing channels. The questions can be modified to reflect new technologies or behaviors as it suits the context of the study. However, it is important to note that one of the significant limitations of any subjective measurement is the self-report bias. Use of this copresence scale should be supplemented with observations and/or interview data to support research findings.

CONCEPTUAL MODEL & RELATIONSHIP TO THEORY

The conceptual model for mixed reality derives from the literature reviewed in Chapter 2 and the results of the qualitative pilot research described in Chapter 3. This model was based on an input-process-output (IPO) framework, where individual and group factors were the inputs influencing mixed reality, process factors were technology multitasking and copresence management, and the outputs were perceived productivity and meeting satisfaction. The IPO model follows a cognitive perspective: people and technology are analyzed as equal parts of an information processing system. Inputs and outputs of information are exchanged between the two as the individual works to perform a specific task with the technological artifact. While the IPO model is well-suited for an individual-level view of mixed reality, it does not model the larger contextual features that influence behavior as offered by social constructionist perspectives.

This difference between the IPO model of mixed reality and a constructionist view is reflected in the qualitative and quantitative portions of this dissertation. In Chapter 4, the qualitative discussion presented an ethnographic decision-tree that modeled the multiple contextual details that individuals thought about before deciding to multitask with technology in a meeting (see Figure 10, p. 136). The IPO framework (reflected in Chapter 5, the quantitative survey results), on the other hand, reduced the likelihood to multitask based on meeting type, polychronicity, and cohesion beliefs. The importance of the social constructionist view is that it provides explanatory power for the behaviors of interest. There exist three main constructionist perspectives which inform a deeper analysis of mixed reality: genre systems, adaptive structuration theory, and situated action. In particular, an analysis of the research findings using the constructionist frameworks elicits responses to the following major questions surrounding this research and not explicitly addressed previously:

1. Are the behaviors and impacts of mixed reality actually different from its analog equivalents (any other face-to-face meeting where people multitask with non-technology artifacts)?

2. Why does technology multitasking persist as a behavior despite the recognition by workers that it can result in information processing losses and on occasion be perceived as rude?

Table 66 is a brief overview of the three theoretical lenses that will be used to respond to these questions.

Constructionist View	**Overview of Theoretical Framework**	**Application to Mixed Reality Theory**
Genre Systems in Organizational Communication (Yates, Orlikowski, & Rennecker, 1997)	Genres are a socially recognized communication form (e.g. a meeting, memo, resume) which have common characteristics for who, how, when and why they are used. Multiple genres are used together to form a genre system of communication which either (1) reinforces the common way of using the genre, or (2) changes the nature of the genre. If these changes to a genre become adopted by others, this turns into a genre variant or may be a new genre.	The traditional face-to-face meeting genre is changed by technology multitasking. A new genre variant emerges with mixed reality—communication is structured differently in mixed reality meetings compared to traditional meetings with analog multitasking.

Adaptive Structuration Theory (DeSanctis & Poole, 1994; Poole & DeSanctis, 1990)	Technology use occurs within a set of structures, primarily the group structure of norms and the technological structure of the system being used (its features). The maintenance of these social structures are reproduced by individual actions. AST is an analytical lens for identifying how individual technology use is an emergent behavior which is then linked to understanding group decision outcomes.	Mixed reality meetings allow individuals to transform parts of the meeting task into an electronic communication maintenance task. A subset of meeting attendees will always perceive technology multitasking as detraction to the face-to-face meeting. Some organizations try to control technology multitasking, but individuals persist in the behavior creating a new norm of acceptability.
Situated Action (Suchman, 1987)	Situated action analyzes user behavior through the emergent moment-by-moment actions of users during a particular activity. There is minimal intentionality in situated action, what happens is always developing ad hoc out of the situation. Structure (norms/rules) emerges after action, and is not pre-determined.	Individuals do not pre-plan how they technology multitask in meetings. Based on the segment of the meeting currently occurring (and adjusting for etiquette), individuals technology multitask.

Table 66: Constructionist Frameworks and Mixed Reality.

Mixed Reality Behavior vs. General Meeting Multitasking

Are the research findings about behavior in mixed reality meetings attributable to technology multitasking, or is it conceivable that the same results would be observed with any form of meeting multitasking? To respond to this question, genre systems are used as an analytical lens to distinguish mixed reality as a unique context with behaviors and outcomes not replicable with analog multitasking.

Genres are an analytical lens used to understand how socially recognized communication forms (e.g. resumes, meetings, memos, e-mail) organize, structure, and shape communication interactions (Yates, Orlikowski, & Rennecker, 1997). Multiple genres interact to create a genre system from which social patterns emerge. For example, the meeting genre is associated with the agenda genre: meeting attendees have an expectation that an agenda will be provided by the meeting leader which will outline the specific topics to be discussed. The agenda informs everyone about the format and topics of the meeting and serves as the structure for shaping who will speak when and on what subject matter. Communication amongst a team tends to organize itself into normative modes that are often implicit and habitual (Yates & Orlikowski, 2002).

This distinction between the mixed reality genre and a face-to-face meeting with other forms of multitasking as a genre can be identified first by organizational-level attempts to control technology multitasking. At SoftwareCorp, there were two instances discussed by Charles where top-level executives asked people to follow a company-wide ban against laptop use during meetings. The executives characterized laptop multitasking as a distraction in face-to-face meetings. Based on Charles's memories, there had been no similar bans against technology use in the workplace previously.

Prior to the proliferation of technology multitasking, managerial articles from the Harvard Business Review (Jay, 1976 and Mankins, 2004) identified two main problems with meetings: that there are too many unnecessary meetings and that meeting communication is unfocused and/or imbalanced (e.g. contributions went on for too long and issues of over- and under- participation of team members). An extensive reading of popular business literature and academic research on meetings found no evidence that the analog equivalents of being distracted or multitasking in meetings (such as doodling, looking at other documents, passing notes) resulted in a significant negative impact that would necessitate organizations issuing edicts banning the behavior. Furthermore, while problematic group members were mentioned in the literature, it was always framed as an issue with the specific member and not the behavior. An examination of the research on counterproductive work behaviors (e.g. Robinson & Bennett, 1995 and Gruys & Sackett, 2003) focuses on modeling specific deviant behaviors by individuals (e.g. misuse of company time for personal matters, property theft, co-worker aggression), but these behaviors are all framed as uniformly undesirable. Mixed reality multitasking might be considered a deviant behavior, but as was demonstrated in this research, it was often beneficial to the organization (e.g. increased communication amongst workers via electronic communication).

Jay's 1976 article on how to run a good meeting identifies purposeful silence by some group members as the only problematic behavior by meeting members; any other issues with meetings are due to communication problems that stem from lack of leadership within the meeting; not that individuals are engaging in distracting behaviors themselves. However, attempts to control technology multitasking have met with limited success; in all instances of this research where participants discussed that there had been a ban, people on the whole preferred to technology multitask and the behavior became the norm again.

Mixed reality meetings are further distinguished as a genre variant of traditional face-to-face meetings because of the way it changes communication. The introduction of technology multitasking into face-to-face meetings changes the communication structure of the meeting in the following ways:

- increased use of electronic communication as an additional channel
- appropriation of non-relevant meeting segments for completing other tasks
- increased access to electronic information to support the meeting task

Traditional meetings with analog multitasking only meet the second criterion – appropriation of meeting time for completing other tasks. While people can create non-electronic backchannels (whispering, paper notes, non-verbal gestures), these channels cannot occur with the same level of privacy, speed, and information richness that technology permits with e-mail and instant messaging. Furthermore, technology multitasking allows the user to communicate with people and access information that are not immediately available in the meeting space, which is not possible with the analog equivalents (e.g. physical papers/artifacts which are outside the meeting space and people who are not online).

Using genre systems as a lens for analyzing communicative practices provides an organizing structure for understanding behavior by examining the why, how, with whom, temporal, and spatial aspects of communication. Mixed reality meetings are distinct from traditional face-to-face meetings as explained by organizational attempts to control the behavior, and the additional access to information and communication that occurs both within and beyond the confines of the meeting space.

The Current Nature of Information Work

The hyperbolic term “info-mania” has been used in the media (e.g. BBC News Online, 1995 and Seattle Post-Intelligencer, 1997) to describe people’s inability to resist constantly checking e-mail or being online. While some of the participants in this research mentioned feeling a compulsion to be online often, most participants described the state of their work as requiring constant attention to e-mail and instant messaging because of the sheer volume of communication that arrived each day. This section discusses how organizational and group factors influence technology multitasking behaviors.

Adaptive structuration theory (AST) posits that technology use can be analyzed as it occurs within a set of organizational and group structures (DeSanctis, Poole, & Dickson, 2000). The AST framework is based on three main variables: structure, task, and interaction frequency, which impact how technologies are used within a group. Technology’s impact on group work is not determined by the technology itself, it must be assessed in combination with characteristics of the team and how the team actually uses the tool. The impact of technology will vary across groups and technology use is a part of the social interaction process of a group. These three variables are discussed in relation to the research findings on how information workers perceive and enact technology multitasking.

Structure at the Organizational Level: There were no organizational norms that explicitly encouraged technology multitasking based on the research data collected. In fact, as was discussed in the previous section, technology multitasking was explicitly discouraged when high-level executives asked employees to not multitask during meetings. In 1995, the global technology company, Hewlett-Packard, published a white paper titled “HP’s Guide to Avoiding Info-Mania” which encouraged employees to use e-mail more thoughtfully (e.g. only send an e-mail if it is really necessary, being more specific with e-mail subject lines). The organizational structure presents itself as opposing mixed reality, yet there exists a mismatch between the expectations of how information workers are expected to perform their work and bans on technology multitasking. Essentially, a contradictory message occurs when upper management bans technology multitasking, yet simultaneously there is an unspoken expectation that employees need to be available to each other electronically for communication and collaboration. The outcome of this contradiction is that structure at the group level overrides organizational structure.

Structure at the Group Level: At the group level, this research found that each individual understood a set of implicit norms for what was acceptable technology multitasking in a given meeting type. These individual beliefs about appropriate behavior in meetings were based on expectations of what the group considered appropriate based on who else was present and how typical it was to witness multitasking amongst the group. Greater familiarity with meeting members led to increased multitasking, but only when there was a plausible work-related reason to use a laptop for a given meeting (which is why no multitasking was reported in staff meetings, though team members were highly familiar in that setting).

One of the reasons why technology multitasking persists as a valued behavior is because of a general societal encouragement that skilled use of information technology equates to increased success in society (DiMaggio & Bonikowski, 2008). Bertrand & Mullainathan (2004) found a significant relationship between receiving a phone call from a potential employer and having an e-mail address on a resume. Employers called prospective job applicants more often when an e-mail address was present compared to similarly qualified resumes without e-mail addresses. While this finding is interesting as a reflection of the value placed on being Internet-savvy, we would expect this finding to become obsolete as e-mail addresses become common across all applicants as this convention diffuses across society. However, the perceived gains from being an Internet user through increased social capital and information and networking opportunities persists. The interview participants in this research discussed how being observed multitasking was perceived positively because it meant that others knew you were valued and needed within the workplace.

Task & Interaction Frequency: Task relevance played a key role in determining the frequency and intensity of technology multitasking. Individuals who perceived that a meeting segment was less relevant would utilize this time period to browse e-mails or answer instant messages. While it is an individual choice to multitask or not, there is a tension that persists between the individual balancing how they want to be perceived by others in the group when multitasking, organizational expectations for communication availability, and the individual's desire to utilize time spent in meetings most effectively.

As a counterpoint toward the structurational view which emphasizes that pre-determined structures (e.g. the features of the group) influence technology use, situated action, on the other hand, views technology use as emergent. With situated action, technology use occurs in the moment and is not pre-planned by the user. While structure can be analyzed in situated action, structure emerges from action and does not exist before.

There exists a "chicken or the egg" debate when analyzing mixed reality using AST and situated action. Do the structures of the organization and group influence technology use, or is it individual behaviors which create the norm for groups and organizations? This research found that typically people did not have a specific plan for when they used their laptop during a meeting, which gives credence to the emergent nature of technology use (situated action). However, structures about proper group etiquette and organizational norms certainly influenced how people decided to use technology. For example, before going in an internal project meeting with Sam at SoftwareCorp, he specifically told the researcher that he would limit his multitasking because his boss would be present in the meeting. While information workers do not pre-plan the specific moment they will use technology in a meeting and for what specific tasks, individuals do take into account organizational and group norms when deciding to multitask.

Summary of Theoretical Perspective of Mixed Reality

This section discussed the results of this dissertation in relation to the social constructionist perspectives of genre systems, adaptive structuration theory, and situated action. The analytical viewpoints of these frameworks were used to respond to two fundamental issues about mixed reality: 1) why it differs from traditional multitasking in meetings and 2) how the culture of information work contributes to mixed reality meetings.

First, the lens of genre systems of organizational communication was used to demonstrate how the changing structure of communication in mixed reality makes it wholly different than these same multitasking behaviors with analog equivalents. Second, adaptive structuration was used to show that norms for technology multitasking are enacted by individuals within the context of the team that they work in. And, situated action was discussed as a counter-theory to the structurational view to show how technology use is often emergent in a given moment, and not a pre-planned set of tasks.

MANAGERIAL CONTRIBUTION

This section provides a set of guidelines for multitasking with technology in meetings. These guidelines are intended to help managers and meeting leaders understand how to improve and structure mixed reality meetings. The recommendations are based on the research findings from this dissertation, with additional triangulation of research on meeting behaviors from Curtis, Hefley, & Miller (2009), Francisco (2007); McFadzen, Somersall, & Coker (1999); Nixon & Littlepage (1992), and Presley & Keen (1975).

Only invite the most relevant people to the meeting

Inappropriate laptop multitasking mainly occurs when someone feels trapped in a meeting where only a small portion or topic is perceived as relevant. If you anticipate needing someone's input on only one of the meeting topics, find out prior to the meeting that person's position and communicate this information as needed to others in the meeting.

Do not place a complete ban on laptop multitasking in meetings

While it's tempting to place a moratorium on laptop multitasking during meetings, doing so is not effective over time as employees are used to accessing technology continuously throughout the work day. Employees spend a majority of their day without ever being told when they should or should not check their e-mail. Employees want to feel trusted that they are responsible enough to organize their work and complete tasks in the way they best see fit. If someone's multitasking is causing a problem for the team, it should be addressed on an individual basis and not by banning the behavior completely.

Do ban or limit laptop multitasking when meeting with external clients

In project teams where everyone already knows each other, few people find it rude when other team members multitask with laptops. However, when meeting with an external client, laptop multitasking can be offensive in these contexts. The client may have a completely different organizational culture and norm toward multitasking and you do not want to leave a bad impression. If you need a laptop in these meetings for taking notes or looking up information, explain why you'll be using your laptop.

Do not be offended if people are multitasking throughout your meeting

In most cases, people are not purposefully trying to be rude when they multitask during a meeting. Employees are juggling multiple projects and responsibilities, and multitasking is just one of the strategies used to keep up with the information-intensive work environment. Cover the most important agenda items first in the meeting when people's attention capacity is at their maximum.

Make meetings shorter, more productive

The longer a meeting spans in time, the more likely people begin to lose focus or want to multitask in order to keep up with other work. Set an expected time length for each of the meeting agenda items that is as short as possible. This suggestion is not intended to rush people through the meeting, but rather as a method to get people to focus their concentration into a manageable amount of effort.

Utilize laptops as a second channel of communication (the backchannel)

Encourage task-oriented use of laptops during meetings by using them as a second channel for communication, typically known as a backchannel. If your team meetings are prone to over-participators (where the meeting discussion is dominated by 1 or 2 people), suggest to your entire team that they all bring laptops to future meetings. Create an instant messaging channel where everyone in the meeting can add to the verbal out-loud discussion through typed comments on the IM channel.

LIMITATIONS

Research Boundaries

Any study of human behavior at work has limitations in both method and analysis given the complex dynamics of groups and organizations. It is important to recognize the following limitations in this research. One concern with this study is that it did not assess individual participants longitudinally which means there is no data in which to infer if technology multitasking behavior or attitudes change over extended periods of time. Changes in job roles and responsibilities or personal preferences for technology multitasking may occur, but it is not possible from this research to identify to what extent people change this behavior and the motivating factors for these changes. While individual changes with technology multitasking was not addressed over multiple years, the overall research presented did span an extended length of time. Across the three-year period in which the dissertation data was collected, participants showed similarity in technology multitasking behaviors and attitudes. This consistency helps support the research conclusions and provides sufficient evidence that this phenomenon exhibits common tendencies across the lives of information workers though future work should address individual-level changes over time.

A second limitation of this research is its focus on standard laptop computers as the technology of interest for studying mixed reality. Laptops were selected as the central technology because they were the most common tool that people used during meetings to multitask (this information stems from the initial pilot interview data first collected on the topic). With this narrow focus on laptop multitasking, however, it is possible that the behaviors and attitudes addressed in this study do not similarly apply to other portable technologies such as smartphones, tablet-style laptops, personal digital assistants, or any other myriad of Internet-enabled mobile work tools that currently or in the future will exist.

The size of a laptop, its screen position, and keyboard all lead to particular affordances for how they can be used and perceptions of its use by people in meetings (see e.g. Bannister & Remenyi, 2008 and Kern & Schiele, 2003). Laptops can obscure a full view of an individual (because the upright screen blocks part of the body), or cause individual users to utilize more table space if the laptop is placed toward one side of the body. Participants were conscious that others could view their laptop screens during meetings, and this in turn impacted which applications they would multitask with during meetings. The sound of typing was also noticed by others in the meeting, which annoyed some people in meetings who never multitasked with technology. These particular characteristics of laptops in meetings may differ from how other technologies are perceived; future research needs to address whether the differences in technology affordances lead to significant behavioral and attitudinal outcomes in group environments.

Another particular and potentially limiting lens of this research is the focus on information workers, specifically those involved in software and web technology companies. These jobs tended to have individuals who remained in the same building/location all day and who all relied heavily on using computers to complete the majority of their work tasks. There are other information-intensive jobs in industries such as finance, healthcare, advertising/sales, and manufacturing, and it is unclear from this research whether the behaviors and attitudes outlined here are consistent for these other work environments. There is also a particular culture associated with technology companies that may shape attitudes toward how it is used and this could differ across different industries.

Methodological Limitations

Methodological limitations with this research include the small number of participants in the case study data. When this research was initially conceived, four case sites were proposed which would have provided more extensive opportunities to observe real world meeting behaviors and perform cross-case analyses. There were difficulties encountered by the researcher in recruiting organizations to participate and achieving permission from the appropriate management channels, so only one case site was obtained. However, this research made an attempt to balance the limited case study data by interviewing eight additional participants who worked at companies all involved in a similar industry (software and web site production). This interview data provided additional real-world contextual background for mixed reality and comparison information for the case study data.

Additional issues with the case study included limited access to participants at SoftwareCorp. Ideally, after each meeting observed with Charles and Sam, the researcher would have implemented a post-meeting questionnaire to each of the other attendees. This questionnaire would have asked participants to describe how they multitasked during the meeting, their observations of other people's multitasking, and how satisfied and productive they felt about the meeting outcomes. This additional data would have provided a more complete picture of the dynamics within the group. Instead, since the researcher was limited with her agreement at SoftwareCorp to study only Charles and

Sam, only the viewpoints of these individual team members were reflected in the analysis.

Furthermore, when assessing real world meetings, this research had minimal scope to measure the value of individual contributions to the meeting discussion and whether the goals of the meeting had been met. Had the researcher been able to spend an extended period of time with each of the case site participants, it would have been conceivable to collect data on how each meeting event contributed to the larger work project and where critical decision making occurred and under what mixed reality contexts. This data would have provided insights into the contextual mechanisms by which technology multitasking contributes to or detracts from meeting outcomes.

Measurement limitations were apparent in the use of the polychronicity construct. In the survey results from Chapter 5, a statistically significant correlation was found for increased multitasking with higher polychronicity scores, but in Wave 2 the relationship was not linear as it was in Wave 1. This conflict in the findings suggests that the measurement for polychronicity may not be capturing the technology multitasking behaviors in mixed reality with enough precision.

Davis, Lee, & Yi (2009) published a newly developed scale for what they term *computer polychronicity*, which is defined as the preference for using two or more computer applications simultaneously and the belief that this is the best way to use a computer. Davis et al. verified with factor analysis that *computer polychronicity* is distinguishable from general polychronicity (people's preference for multitasking in all aspects of their life, not just computer usage). This new research identifying *computer polychronicity* as a trait that is different from general polychronicity suggests that the findings in this research may not be demonstrating consistent results because of the reliance on a general polychronicity scale. It is conceivable that Davis et al.'s scale may better assess people's preference for technology multitasking, and therefore provide a better starting point for assessing outcome variables in the future.

Future Research Ideas

The limitations addressed in this section provide ample opportunity for future research ideas. First, in regards to examining information work longitudinally, research that studies mixed reality meetings in relation to project lifecycles would be beneficial. Do technology multitasking behaviors change depending on the stage of a work project or is it a behavior that people exhibit consistently across time? This type of study would provide a basis for addressing how stress, increased communication, and differing task demands influence how workers maintain or change their multitasking behaviors.

For the limitation of focusing on laptop computer use only, there is still a need for research that examines if specific technology tasks impact individual users and bystanders more than others. For example, is instant messaging more disruptive to users than e-mail because its communication exchanges generally occur more rapidly? Or, perhaps e-mail is more detrimental while multitasking because it is typically associated with longer and more formal communication structures which require increased cognitive processing power.

How are bystanders to laptop multitasking impacted by these differences in tasks? Are bystanders more prone to try and observe someone else's behavior when it's web browsing instead of e-mail? To what extent do the noises or movements someone else makes while technology multitasking impacting bystanders (e.g. the sounds of clicking, or hand movements)? While the results from this research suggest that familiar team members are not bothered from an etiquette standpoint by others who multitask within their group, questions still remain whether other's abilities or performance are impacted in mixed reality settings.

Another possible study idea is a sociological examination that fully addresses the conflicting norms and organizational structures surrounding technology multitasking as it relates to issues of power. A sociological investigation of mixed reality would help elicit a better understanding of why this phenomenon causes strife between individuals, groups, and organizations. Also, action-oriented design research that implements a particular way of technology multitasking into a work group and measures attitudes and outcome changes would provide additional meaningful data about the impacts of mixed reality in organizations.

BROADER IMPLICATIONS & CONCLUDING THOUGHTS

This research provides a contextually-grounded foundation for studies involving group dynamics, technology multitasking, and social effects of technology use in human-computer interaction and organizational behavior. One of the significant implications of this research is its examination of how and why information workers place value on electronic communication over face-to-face communication. As discussed earlier in this chapter, information workers typically spend only a few minutes on each task before switching to another. This continuous set of short-length activities may suggest changes in not only the quality and depth of work produced by an individual, but also changes in how groups work together.

Does the quality of work produced diminish as information work becomes fragmented? Information workers spend the majority of their day using computing technologies which are used not only as the tool to create and manage knowledge (e.g. writing software code, creating presentations, editing documents), but also as the primary tool to communicate and coordinate this work (e.g. e-mail, instant messaging, calendars). When all facets of work are dependent on computing technologies, it can be challenging to find a work space that is uninterrupted and provides opportunity for an information worker to focus and immerse themselves into a complex task.

While the idea of information work being associated with information overload is not a new concept (for a review of information overload research see Eppler & Mengis, 2004), what this research has attempted to distinguish and characterize is that the study of information work cannot be confined to studying technologies without incorporating other contextual features. Improvements in information work and management of work tasks will come not only from enhancing technologies but must also be associated with recognition of how interruptions and competing electronic and verbal communications integrate and impact the state of work too. Future research must address how the quality of work and the worker changes within this environment.

Furthermore, perceptions of productivity when multitasking may be harmful to information workers. If individuals believe that they are skilled or talented at multitasking, this may be detrimental because they do not have the foresight to modify their own behavior because they believe they are successful at the act. As Dunning, Johnson, Ehrlinger, & Kruger (2003) identified in their research on how people evaluate their own skills, poor performers are unable to identify why they do not have the correct answer (whereas high performers may not know the correct answer either, but they have the meta-cognitive ability to recognize why they lack this knowledge.) If information workers are not given insight into the impact of multitasking, they will not have the capacity to judge how their use of technology affects work.

We live in a world that is engulfed by numerous information and communication technologies that are intended to support our need to socialize, work and communicate together. The impact of these technologies on our lives must be examined so that people have insight on how to best utilize these tools. Our behaviors with technology require reflection and assessment, and the results of this dissertation are a contribution to this endeavor.

Appendices

APPENDIX A: INTERVIEW GUIDELINE FOR QUALITATIVE PHASE

Job Role

1. Tell me about the company you work for.
2. Tell me about your job.
    a. How long have you held this role?
    b. How long have you been with the company?
    c. What did you do previously?
    d. How does your typical work day begin?
    e. What do you do first when you arrive to work?
3. Who do you work with?
    a. What is the reporting structure?
    b. Do you manage the work of others?
    c. What other teams do you interact with? How frequently?
    d. Who do you communicate with on a daily basis to accomplish work?

Work Projects

1. Tell me about the main projects you work on.
    a. What is your role within the project?
    b. How long does the project last?
    c. What are the typical tasks completed for the project?
    d. How do you organize your work tasks?
    e. Describe the layout of your desk area.

Technologies at Work

1. What types of technologies are provided to you at work?
    a. Describe your technological set-up.
    b. What software applications do you use most frequently?
    c. Does the company restrict the software you can use?
    d. Does the company restrict what web sites can be used?

Communication Patterns

1. How frequently do you check e-mail?
    a. How do you organize your e-mail?
    b. How frequently do you search through older e-mails? Under what context?
2. How frequently do you receive instant messages?
3. How frequently do you send instant messages?
4. Why would you send an e-mail versus instant messaging (or vice versa)?

5. Tell me about the interruptions you have during your work day.
    a. How frequently do people stop by your cube?
6. How frequently do you use your telephone at work?

Meetings

1. What are the typical meetings you have for work?
    a. For each of these meetings, how frequently do they occur?
    b. Who leads these meetings?
    c. Is there an agenda sent out in advance?
    d. How many people are in attendance?
2. Do you multitask during meetings?
    a. Do you use your laptop during meetings?
    b. Do you use your mobile phone during meetings?
    c. How many people in your project meetings also multitask?
3. Are there rules about multitasking during meetings?
    a. Who determines these rules?
    b. How do people learn these rules?
4. How do you feel about multitasking during meetings?
    a. Do you ever feel conscientious when doing so?
    b. Do you try and purposefully participate out loud when multitasking?
5. What do you do when technology multitasking?
    a. Are you answering emails?
    b. Are you answering instant messages?
    c. Are you working on other work projects?
    d. Are you taking meeting notes?
    e. Do you talk with other people in the meeting also on laptops?

APPENDIX B: PILOT QUESTIONNAIRE ITEMS

Pilot 1
Polychronicity Q16a. I prefer to do two or more activities at the same time Q16b. I typically do two or more activities at the same time. Q16c. Doing two or more activities at the same time is the most efficient way to use my time. Q16d. I am comfortable doing more than one activity at the same time. Q16e. I like to juggle two or more activities at the same time.
Technology Use Norms Q12a. The more people there are in the meeting, the less I use my laptop. Q12b. When my boss or supervisor is in the meeting, I use my laptop less. Q12c. When upper/senior management is in a meeting, I use my laptop less. Q12d. If no one else is using a laptop in the meeting, I won't use one either.
Cohesion Beliefs Q14a. It is important for me to be liked by other team members. Q14b. The project meetings I attend are generally disorganized. Q14c. I can trust my teammates to do their fair share of the work. Q14d. My participation in project meetings is critical to the team's success. Q14e. I prefer not to spend time with members in the group. Q14f. We can say anything in the meeting without having to worry.
Copresence Management Q13a. Before going into a meeting, I change my instant message status to let people know that I'm busy. Q13b. While using my laptop in a meeting, I make sure to nod my head a little to show that I am paying attention. Q13c. When using a laptop in a meeting, I purposefully try and participate in the meeting to show that I am paying attention. Q13d. I usually leave my laptop entirely open for the entire meeting.
Meeting Satisfaction Q15a. I am more satisfied in meetings when I can use my laptop. Q15c. It bothers me when other people in a meeting use laptops. Q15e. I am stressed out in meetings because of multitasking.
Perceived Productivity Q15b. Having a laptop in a meeting makes me more productive. Q15d. Meetings are less productive because people are distracted by technology.

Pilot 2
Polychronicity Q4a. I prefer to do two or more activities at the same time Q4b. I typically do two or more activities at the same time. Q4c. Doing two or more activities at the same time is the most efficient way to use my time. Q4d. I am comfortable doing more than one activity at the same time. Q4e. I like to juggle two or more activities at the same time.
Technology Use Norms Q7a. Everyone on my project team knows when it is appropriate to multitask with a laptop. Q7b. I wish my team had more explicit rules about how laptops should be used during meetings.
Cohesion Beliefs Q5a. Team members make an effort to participate in meeting discussions. Q5b. Team members share the workload evenly. Q5c. My team does not coordinate our meeting activities very well. Q5d. It is important for me to be liked by other members of the team. Q5e. Overall, I feel like I am an essential part of my team.
Copresence Management Q8c. I respond to incoming instant messages while in a meeting. Q8d. I use my laptop during meetings to maintain communication with others outside of the meeting. Q9a. I tend to use my laptop for non-meeting related tasks (e.g. checking e-mail / working on other projects).
Meeting Satisfaction Q10a. I am more satisfied in meetings when I can use my laptop. Q10b. I find it disruptive when other people use laptops in a meeting. Q10c. I feel self-conscious when I multitask with a laptop in a meeting.
Perceived Productivity Q10d. Having a laptop in a meeting leads me to be more efficient at my job. Q10e. Having a laptop in a meeting makes me more effective at my job. Q10f. Having a laptop in a meeting allows me to be more productive. Q10g. Having a laptop in a meeting allows me to produce better quality work.

APPENDIX C: SURVEY QUESTIONNAIRE - SOFTWARECORP (WAVE 1)

MEETING TYPES

Thinking about the typical meetings you attend for work, please answer the following questions.

1. How often do you attend a scheduled **face-to-face meeting** with 3 to 14 people?
    a. Never
    b. Once a week or less
    c. 2 to 4 times a week
    d. 3 to 7 times a week
    e. 8 or more times a week
2. How often do you attend a scheduled **telephone conference call meeting** with 3 to 14 people?
    a. Never
    b. Once a week or less
    c. 2 to 4 times a week
    d. 3 to 7 times a week
    e. 8 or more times a week
3. How often do you attend a scheduled **Halo Telepresence** meeting with 3 to 14 people?
    a. Never
    b. Once a week or less
    c. 2 to 4 times a week
    d. 3 to 7 times a week
    e. 8 or more times a week
    f. I've never heard of a Halo Telepresence meeting
4. Which meeting format do you prefer the most?
    a. Face-to-face meetings
    b. Telephone conference calls
    c. Halo Telepresence meetings
    d. No preference
    e. Other (Please specify)

INDIVIDUAL POLYCHRONICITY

Please rate your agreement level with the following statements as it pertains to your life in general, not just at work (7-point Likert scale, Strongly Disagree to Strongly Agree).

5a. I prefer to do two or more activities at the same time.
5b. I typically do two or more activities at the same time.
5c. Doing two or more activities at the same time is the most efficient way to use my time.
5d. I am comfortable doing more than one activity at the same time.
5e. I like to juggle two more activities at the same time.

COHESION BELIEFS

Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements (7-point Likert scale, Strongly Disagree to Strongly Agree).

6a. Team members make an effort to participate in meeting discussions.
6b. Team members share the workload evenly.
6c. My team does not coordinate our meeting activities very well.
6d. It is important for me to be liked by other members of the team.
6e. Overall, I feel like I am an essential part of my team.

7. Do you typically multitask with a laptop computer during project meetings? (Yes/No)

8a. Everyone on my project team knows when it is appropriate to multitask with a laptop.
8b. I wish my team had more explicit rules about how laptops should be used during meetings.

COPRESENCE MANAGEMENT

Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements (7-point Likert scale, Strongly Disagree to Strongly Agree).

9a. If my boss or upper management is also in the meeting, I multitask on my laptop less.
9b. When using a laptop during meetings, I make a point to participate in the meeting to show that I am paying attention.
9c. I respond to incoming instant messages while in a meeting.
9d. I use my laptop during meetings to keep up communication with others outside of the meeting.

10a. I tend to use my laptop for non-meeting related tasks (e.g. checking e-mail / working on other projects).
10b. I tend to use my laptop for meeting related tasks (e.g. taking notes / looking up information relevant to the meeting).
10c. I only use my laptop during segments of the meeting that are less relevant to me.
10d. It is easy for me to follow the meeting discussion while simultaneously using my laptop.

MEETING SATISFACTION

Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements (7-point Likert scale, Strongly Disagree to Strongly Agree).

11a. I am more satisfied in meetings when I can use my laptop.
11b. I find it disruptive when other people use laptops in a meeting.
11c. I feel self-conscious when I multitask with a laptop in a meeting.
11d. Having a laptop in a meeting leads me to be more efficient at my job.
11e. Having a laptop in a meeting makes me more effective at my job.
11f. Having a laptop in a meeting allows me to be more productive.
11g. Having a laptop in a meeting allows me to produce better quality work.

DEMOGRAPHICS

12. What is your employment status? (Full Time, Part Time, Other)
13. In which area is your job? (Accounting/Finance, Administrative, Development/Engineering, Human Resources, Legal, Marketing, Project Management, Quality Assurance, Sales, Other)
14. About how many years ago did you start work at SoftwareCorp? (2 years or less, 3 to 7 years, 8 to 15 years, 16 years or more)
15. About how many years ago did you start in your current position? (2 years or less, 3 to 7 years, 8 to 15 years, 16 years or more)
16. Do you supervise the work of other employees on a day-to-day basis? (Yes, No, Don't Know)
17. If you have any additional thoughts or comments regarding technology multitasking at SoftwareCorp meetings, we would love to hear your opinions. (Optional, Open ended)

APPENDIX D: SURVEY QUESTIONNAIRE - ZOOMTECH PANEL (WAVE 2)

MEETING TYPES

Thinking about the typical meetings you attend for work, please answer the following questions.

1. How often do you attend a scheduled **face-to-face meeting** with 3 to 14 people?
    a. Never
    b. Once a week or less
    c. 2 to 4 times a week
    d. 3 to 7 times a week
    e. 8 or more times a week
2. For the primary project you work on right now, where are the face-to-face meetings typically held? (Check all that apply)
    a. Conference rooms at my company
    b. Conference rooms at another location of my company
    c. Conference rooms at a different company
    d. In public locations (e.g. coffee shops)
    e. On-site at the project's location (e.g. construction site)
    f. Other ________________
3. Do you typically multitask with a laptop during meetings?
    a. Yes
    b. No

MEETING TYPE & COPRESENCE

Please rate your frequency level with the following statements (7-point Likert scale, Never to Very Often).

4. How often do you multitask with a laptop computer during each of the following meeting types?
    a. Staff Meeting
    b. Project Meeting with External Clients
    c. Project Meeting (Internal Only)
    d. Lecture/Demonstration Meeting
    e. Sales/Pitch Meeting
    f. Company "All Hands" Meeting
5. Please rate how typical the following behaviors are for you when you're multitasking with your laptop in project meetings:
    a. I try and make occasional eye contact with whomever is speaking.
    b. I make a point to participate in the meeting discussion.
    c. I nod my head slightly when I hear something that I agree with.
    d. I lower or close my laptop screen when I'm done multitasking.

ELECTRONIC COPRESENCE & TECHNOLOGY SELF-EFFICACY

Please rate your agreement level with the following statements (7-point Likert scale, Strongly Disagree to Strongly Agree)

6. Thinking about the ways you use your laptop during a meeting, please rate your agreement level with the following statements:
    a. I notice all new incoming e-mail messages when in a meeting.
    b. I write and respond to e-mail messages during a meeting
    c. I send instant messages to other people in the meeting who have laptops.
    d. I send instant messages to work colleagues who are not in the meeting.
    e. I won't initiate instant message conversations, but I will reply to incoming IMs.
    f. I find it essential to be online throughout the meeting so that I can communicate with others who are not in the room.
7. Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements:
    a. It is easy for me to follow the meeting discussion while simultaneously using my laptop.
    b. I tend to use my laptop for non-meeting related tasks (e.g. checking e-mail / working on other projects).
    c. I tend to use my laptop for meeting related tasks (e.g. taking notes / looking up information relevant to the meeting).
    d. I only use my laptop during segments of the meeting that are less relevant to me.

MEETING SATISFACTION & PERCEIVED PRODUCTIVITY

Please rate your agreement level with the following statements (7-point Likert scale, Strongly Disagree to Strongly Agree)

8. Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements:
    a. I am more satisfied in meetings when I can use my laptop.
    b. It bothers me when other people in a meeting use laptops.
    c. I feel self-conscious when I multitask with a laptop in a meeting.
    d. I dislike it when other people in the meeting glance at what I'm doing on my laptop.
9. Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements:
    a. Having a laptop in a meeting allows me to be more productive.
    b. Having a laptop in a meeting leads me to be more efficient at my job.
    c. Having a laptop in a meeting makes me more effective at my job.
    d. Having a laptop in a meeting allows me to produce better quality work.

COHESION BELIEFS

Please rate your agreement level with the following statements (7-point Likert scale, Strongly Disagree to Strongly Agree)

10. Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements:
    a. Team members make an effort to participate in meeting discussions.
    b. Team members share the workload evenly.
    c. Our team meetings are coordinated and organized well.
    d. It is important for me to be liked by other members of the team.
    e. Overall, I feel like I am an essential part of my team.
11. Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements:
    a. Even when I can't see their laptop, I can tell when someone is checking/writing e-mail in a meeting.
    b. Even when I can't see their laptop, I can tell when someone is sending/receiving instant messages in a meeting.
    c. Even when I can't see their laptop, I can tell when someone is browsing the web in a meeting.
12. Thinking about the project meetings you spend the most time on right now, please rate your agreement level with the following statements:
    a. I wish my team had more explicit rules about how laptops should be used during meetings.
    b. Everyone on my project team knows when it is appropriate to multitask with a laptop.

INDIVIDUAL POLYCHRONICITY

13. Please rate your agreement level with the following statements as it pertains to your life in general, not just at work (7-point Likert scale, Strongly Disagree to Strongly Agree).
    a. I prefer to do two or more activities at the same time.
    b. I typically do two or more activities at the same time.
    c. Doing two or more activities at the same time is the most efficient way to use my time.
    d. I am comfortable doing more than one activity at the same time.
    e. I like to juggle two more activities at the same time.

DEMOGRAPHICS

14. What is your gender. (Female / Male)
15. What is your age range?
    a. 18 to 24 years old
    b. 25 to 34
    c. 35 to 44
    d. 45 to 54
    e. 55 to 64
    f. 65 years or older
16. In which US state or territory is your job located?
17. What is your employment status (Full Time / Part Time / Other)
18. What is your job title?
19. About how many years ago did you start work for your current employer? (2 years or less, 3 to 7 years, 8 to 15 years, 16 years or more)
20. About how many years ago did you start in your current position for your current employer? (2 years or less, 3 to 7 years, 8 to 15 years, 16 years or more)
21. Do you supervise the work of other employees on a day-to-day basis? (Yes, No, Don't Know)
22. How would you describe your place of work?
    a. Large corporation
    b. Medium size company
    c. Small business
    d. Federal, state or local government
    e. School or educational institution
    f. Non-profit organization
    g. Other (Please specify)
23. Which of the following best describes your organization's primary industry?
    a. Advertising/Public Relations
    b. Automotive
    c. Broadcasting
    d. Computer – Hardware
    e. Computer – Software
    f. Consumer Goods
    g. Education
    h. Financial
    i. Government
    j. Healthcare
    k. Insurance
    l. Internet/New Media
    m. Manufacturing
    n. Natural Resources
    o. Restaurant
    p. Utilities
    q. Other (Please specify)

APPENDIX E: SURVEY RECRUITMENT E-MAIL AT SOFTWARECORP

Dear SoftwareCorp Employee:

I am a Ph.D. candidate at the University of Texas at Austin and I am conducting a study about multitasking during meetings. For example, have you ever been in a meeting where people are busy working on their laptop while participating in the meeting? Do you view this behavior as productive or distracting, or perhaps a little bit of both? We're interested in finding out the frequency of this kind of multitasking and your opinions on this topic. Through your participation, I hope to be able to analyze what motivates this behavior and the impact it has on team cohesion and productivity beliefs.

The survey questionnaire is approximately 15 questions and the estimated completion time is between 3 and 6 minutes. Your responses will not be identified with you personally and participation is voluntary.

Your participation is highly valued as you possess the experience and knowledge we are seeking to understand. The validity of the results is also greatly improved with a high response rate, so I appreciate the time you are taking from your busy day to participate.

SoftwareCorp has given permission for this survey and in exchange is receiving a complimentary executive report with the results and analysis. A copy of this report is also available to you, just contact me at the e-mail address below and I will send you a message when it's done. The researcher will be using the data as part of her doctoral dissertation.

Thank you in advance for participating in this research project.

Lisa Kleinman
Ph.D. Candidate
University of Texas at Austin, School of Information
kleinman@ischool.utexas.edu

APPENDIX F: SUPPLEMENTARY DATA

Time Segment	Location	Primary Task	Secondary	Tertiary	Task Changes
9:00-9:30	Desk	Bug Scrub	E-mail		7
9:30-10:00	Desk	Bug Scrub	E-mail	Instant Messaging	9
10:00-10:30	Desk	Bug Scrub	Stop By		5
10:30-11:00	Desk	E-mail	Instant Messaging	Performance Evaluations	8
11:00-11:30	Desk	Bug Scrub	Phone		5
11:30-12:00	Desk	Bug Scrub			2
12:00-12:30	Off-Site	Lunch			——
12:30-1:00	Off-Site	Lunch			——
1:00-1:30	Conference Room	Meeting Participant	Multitasking on Laptop		——
1:30-2:00	Conference Room	Meeting Participant	Multitasking on Laptop		——
2:00-2:30	Desk	Bug Scrub	E-mail	Instant Messaging	4
2:30-3:00	Desk	Phone	E-mail	Instant Messaging	4
3:00-3:30	Conference Room	Meeting Leader			——
3:30-4:00	Desk	Bug Scrub	E-mail		5
4:00-4:30	Other Employee's Desk	1 on 1 Meeting			——
4:30-5:00	Desk	Bug Scrub	E-mail		3
5:00-5:30	Desk / Other Desk	1 on 1 Meeting	Bug Scrub		3
5:30-6:00	Desk	Bug Scrub	E-mail		1
6:00-6:30	Desk	Bug Scrub	E-mail		1

Table 67: Sam's Time/Task Log for Day 2.

Time Segment	Location	Primary Task	Secondary	Tertiary	Task Changes
8:00-8:30	Desk	E-mail	Conference Call	Creating on PowerPoint Presentation	4
8:30-9:00	Desk	E-mail	Creating PowerPoint Presentation		4
9:00-9:30	Conference Room	Meeting Participant	Multitasking on Laptop		——
9:30-10:00	Conference Room	Meeting Participant	Multitasking on Laptop		——
10:00-10:30	Conference Room	Meeting Participant	Multitasking on Laptop		——
10:30-11:00	Conference Room	Meeting Leader			——
11:00-11:30	Conference Room	Meeting Leader			——
11:30-12:00	Conference Room	Meeting Participant			——
12:00-12:30	Conference Room	Meeting Participant			——
12:30-1:00	Conference Room	Meeting Leader			——
1:00-1:30	Conference Room	Meeting Participant	Multitasking on Laptop		——
1:30-2:00	Desk	E-mail	Stop by Interruption		2
2:00-2:30	Conference Room	Meeting Participant			——
2:30-3:00	Desk	E-mail	Working on Spreadsheet		6
3:00-3:30	Desk	Conference Call	Working on Spreadsheet		3
3:30-4:00	Desk	Conference Call	Working on Spreadsheet		3
4:00-4:30	Desk	Break from work, talking with researcher			——

Table 68: Charles's Time/Task Log for Day 1.

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Vita

Lisa Kleinman was born in Portland, Oregon on December 7, 1977 to Theodore and Han Pun Kleinman. She attended The Catlin Gabel School in Portland for her high school education. In 1995, Lisa moved to Pittsburgh, Pennsylvania to attend Carnegie Mellon University where she graduated with university honors and was granted a B.S. in Information & Decision Systems with additional majors in Human-Computer Interaction and Philosophy. She then moved to San Francisco, California and worked as a user interface designer, specializing in information architecture and usability for large scale e-commerce web sites.

Lisa returned to academia in 2001 at Portland State University to attend an accelerated masters program and was granted a Master of Business Administration. Immediately following, she entered the School of Information doctoral program in 2002. During her time at the University of Texas at Austin, Lisa worked as a graduate researcher on experimental studies of electronic text readability. She also regularly published her research at the ACM Conference on Human Factors (CHI) and the American Society for Information Science & Technology (ASIS&T). In 2010, Lisa moved to San Diego, California to join Nokia Mobile Phones as a User Experience Lead.

Permanent address: 195 Scenic Ridge Court, Redmond, OR, 97756

This dissertation was typed by the author.